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"Enterprise" & Company (Foundries), Limited

The statement is so often heard that the "tied" foundries are rarely as efficient as concerns whose job it is to sell on the open market. Obviously there are many noteworthy exceptions and, moreover, these exceptions are probably amongst the most efficient plants because they can tool up for a limited range of products. The average "tied" foundry, however, loses something because it is so often regarded either as a convenience or a nuisance. The managing director is not usually a foundry technician, and so long as the department provides components at a reasonable price, he worries but little as to the efficiency of the methods of production. He has so many calls for new plant from the various departments which can arithmetically show a substantial contribution to the profit account at a point nearer to the finished product than the genesis, that the foundry tends to become neglected. Managers of "tied" foundries always seem worried about their costs, as they hear that the purely foundry concerns having similar equipment and methods can produce apparently much more cheaply. One "tied" foundry had "elastic walls," its area depended for many years on whether it could or could not produce more cheaply than the buyer's quotations. Hence the worry of its chief executive.

A recent visitor to this office related how in earlier days his quite important company made their own castings. He was never sure whether the foundry department was operating at a profit or loss, but after losing three large castings in a row he sold the department to a foundryman, and since then not only have his worries ceased, but he is convinced that he is buying more cheaply; moreover, by the arrangements he made, he is sure of preferential supplies. In these days of subsidiary companies, the action related above if extended might very well result in the overall improved efficiency of the industry.

Dare we suggest that some—not all—of the foundries of Government departments and nationalized industries might be similarly treated? We are convinced that where departments can operate as units having their own name and separate identity, more enthusiasm for progress is generated. The fact that the concern really belongs to some other with an entirely different name does not usually enter into the picture. One effect of such an arrangement is that such separate companies do not have to carry overheads, which may not rightly be theirs. Thus we hope to see in the future many more enterprises carrying the title . . . & Company (Foundries), Limited. This action has already been taken in quite a few cases and we are convinced that the companies concerned do not regret their decision.

F

International Foundry Congress, 1953

The *Association Technique de Fonderie*, 2 Rue de Bassano, Paris (XVI), has now issued the prospectus for the next international congress to be held in Paris from September 19 to 27 next year. Three honorary presidents have been appointed to the organizing committee. They are Professor A. Portevin; Professor P. Chevenard, both members of the *Institut de France*, and Mr. J. Lobstein, a past-president of the International Committee. The president is Mr. P. Muguet, who is supported by the following vice-presidents: Mr. G. Rivoire; Mr. R. R. Meyer; Mr. J. Laine; and Mr. R. Jacquemart. The general manager is Mr. A. Débar. The treasurer, Mr. H. Prevost, with Mr. E. Moustacas as assistant. The general secretary, Mr. G. Hénon and the membership is composed of Mr. A. Brizon; Dr. P. Bastien, Dr. M. Ballay, Mr. D. Waeles, Mr. Chas. Koehler and Mr. H. Baehr. Tours to include works visits are to follow the conclusion of the Congress.

The following is schedule of subjects into which the organizers would like the papers submitted to fall:—(1) New control and acceptance tests for castings stressing non-destructive testing; gas in cast products. (2) Improvements in working conditions to include safety; colour schemes; dust and noise reduction; heating, lighting and ventilation; and (3) foundry operation economics. The last day for the reception of papers is October 30, 1952. The length of each contribution is limited to 25 pages of 25 lines, to include illustrations, tables, etc.

Sorting of High-speed Steel

Mr. A. M. Armour, writing in the Metropolitan Vickers Gazette, on the sorting of tungsten-steel from carbon-steel scrap, gives the following useful hints:—

It is well known that high-chromium-bearing steels are very resistant to rusting. It is not generally realized, however, that the 10 to 30 per cent. tungsten steel alloys also are to a large extent resistant to rusting. The fact that this resistance is much superior to that of carbon steel can be made to furnish a very easily recognizable distinction between the two alloys. Rusting is lengthy, but it can be markedly accelerated by cleaning a small part of the surface with emery wheel or cloth, wetting it with a strong solution of ammonium chloride (sal-ammoniac) in water, and leaving it in the air while still wet. In about fifteen minutes, the carbon-steel turns golden brown with rust, whilst the high-speed steel remains more or less free from rust, depending on the alloy. With practice in the use of the method, the degree of discrimination amongst alloys improves.

This extremely simple and cheap test has been described so that it may be used by all who need to discriminate between high-carbon steel and high-speed steel. Thus the sorting of tool-steel scrap will be helped, and the tungsten-bearing material salvaged for future use to the benefit of the country's imports. The reclamation of tungsten from tool tips or from grinding swarf and the like is not such an economic proposition.

Index to Vol. 92

The index to Vol. 92, January to June, 1952, of the FOUNDRY TRADE JOURNAL is now ready. Readers who would like an index, and who are not already on the index mailing list, should apply direct to the Publishing Office, 49, Wellington Street, Strand, London, W.C.2.

I.V.E. Section Notes

A visit by members of the southern section of the Institute of Vitreous Enamellers to Paris has now been arranged from Thursday, September 25, to Tuesday, September 30. The programme is as follows:—

September 25

Arrive in Paris in the late afternoon.

September 26

Morning: Visit to the laboratory of the *Centre Technique des Industries de la Fonderie*, to study researches now in progress on the quality of cast iron for vitreous enamelling. Afternoon: Visit to the works of the Societe Francaise des Fers Emailles (domestic-equipment manufacturers) and possibly one other sheet enamelling works.

September 29

Visit to the works of Gerard-Becuwe (heating equipment and baths) at Soissons. Evening: Dinner by invitation of the Syndicat National des Emailleries sur Tôle and the Union des Fabricants d'Appareils de Chauffage et de Cuisine Domestique.

September 30

Morning: Return to London. This visit is primarily intended for members of the southern section, and it will be necessary to restrict the size of the party. Members from other sections who are interested are invited to communicate immediately with J. Hooper, 49, Wellington Street, London, W.C.2. It is expected that the inclusive charge covering travelling, meals and hotel will not exceed £36.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

THE WHITE PAPER

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—In spite of your very excellent editorial of July 31 entitled "A Marriage Has Been Arranged," I find that few, if any, ironfounders have read the Government's White Paper*. May I suggest, through your columns, that all ironfounders should obtain a copy of the White Paper and study the Government's proposals for the future control of iron and steel foundries?

Yours, etc.,
C. H. KAIN,
Lake & Elliot Limited, Braintree, Essex.
August 20, 1952.

* "Iron & Steel Industry," Command 8619, price 4d. from H.M. Stationery Office.—EDITOR.

Conference Paper Author

Dr. H. T. Angus is the Author of the Paper "Strength, Structure and Composition of Unalloyed Grey Iron," printed on page 239 of this issue. He began his education at King Edward VI Grammar School, Aston, Birmingham, going on to Leeds University, where he obtained the degree of M.Sc. in fuel and metallurgy in 1925, and Ph.D. in metallurgy in 1927. He held the position of chief chemist and metallurgist at the Parkinson Stove Company Limited, Stechford, Birmingham from 1927 to 1945. In the latter year he joined the British Cast Iron Research Association as development manager. He has contributed papers to various technical institutions, including the Institute of Metals, the Society of Chemical Industry, and the Institute of British Foundrymen, giving the exchange paper to the American Foundrymen's Society in 1951.

Melting Control by Cupola Pyrometer*

By R. I. Taylor

It had been clear to the Author for some time that present-day methods of cupola control, based on volume and pressure meters, even when operated by a well-trained cupola staff, leave much to be desired. It was apparent that there was a lack of knowledge of the varying conditions of the melting zone and work was put in hand with the object of studying combustion within the cupola itself.

During the course of experimental work, it was found that temperature measurements taken a few feet down the stack of a cupola during operation seemed to vary according to the prevailing melting conditions. It was therefore decided to record these results continuously and to compare the information obtained with the actual physical conditions of the metal as tapped. Surprisingly enough, it was noted that many variations in the furnace conditions had a direct bearing on pyrometer readings, in fact after making tests under close observation, it was found that the pyrometer reading was in direct relation to the condition of the melting zone. After a further study had been made of temperature readings in relation to metal conditions it was found possible to use the pyrometer completely to control the running of the cupola.

Equipment Used

The equipment which is being used in the Author's foundry is a continuously-recording pyrometer range 0 to 1,200 deg. C. with the couple inserted through the wall of the cupola and protruding inside some 3 to 4 in. beyond the lining. The position of the couple is important; for instance, on a cupola of 30 in. int. dia. and 16 ft. to the charge hole, it should be located at a distance of about 13 ft. above the main tuyeres and at least 2 ft. below the minimum height to which the charges are allowed to fall during normal operation (see Fig. 1). The couple should be of the industrial type, protected in the manner usually adopted for immersion in molten metal.

Position of Thermocouple.—The choice of the position of the thermocouple was reached after much exploratory work. In order to obtain consistent readings from a couple inserted at a position where the charges are to pass it continuously, it is necessary that the charges should at that point have reached some equilibrium with the flue-gas temperature. On the other hand, to insert the thermocouple at a point too low in the stack would present the problem of preventing actual fusion of the couple during the blowing down. The suggested position gives a working temperature in the region of 500 deg. C. and a maximum temperature at blowing down of approximately 1,150 deg. C., which is about the maximum at which a couple of this type may be used repetitively for significant periods.

A single pyrometer gives a satisfactory reading, but where a better installation is contemplated, it may be useful to obtain an average reading from several couples inserted round the cupola at the same level. In this case, the couples are connected in series and an extra series resistance is put in the meter circuit to compensate for the higher voltage output obtained.

Adaption to Cupola Practice

The full and effective use of the installation depends upon an existing good cupola practice, and it is assumed that the charges in the stack are maintained at a certain minimum height, which must always be above the couple level, preferably 2 ft. above, otherwise inconsistent results will be obtained.

With the equipment set-up as described, it has been stated that the instrument will yield temperatures bearing a direct relation to bed height and

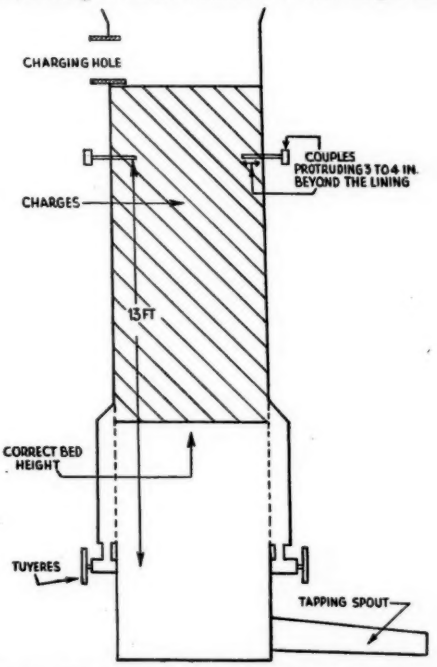

FIG. 1.—*Diagrammatic View of the Cupola showing the Point at which the Thermocouple is inserted.*

* Method developed at Suffolk Iron Foundry (1920) Limited, where the Author is chief metallurgist.

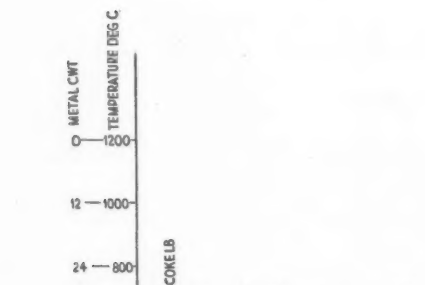

FIG. 2.—*Chart for Ascertaining the Metal available in the Cupola during the Blowing-down Period.*

melting zone conditions. This follows from the fact that the bed temperature and height affect directly the temperature of ascending flue gases which are preheating the charges passing the thermocouple. If the flue-gas temperature decreases, the preheat available to the charges is also reduced and when these are melted they must absorb still more heat from a bed which is already at a lower temperature or height. In this way, the metal temperature progressively decreases although some considerable time elapses between a reduction in pyrometer reading and a similar reduction in metal temperature.

From the above, it will be evident that a deterioration in bed condition is shown immediately on the instruments and yet some time before a serious effect is noticed in the temperature of the metal as tapped. A corrective applied to the charge on receipt of the warning from the couple arrives at the melting zone before the deterioration of the bed has reached a stage at which the melt lacks sufficient superheat.

Calibration

Having shown the nature of the readings obtained from the arrangement, it is now necessary to standardize and calibrate the temperature readings in terms of melting conditions in order to make full use of the information available.

For this, it is essential to obtain all the following information as accurately as possible. The cupola should be run for a three-day period (three "blows") and the following observations recorded:—

1. After supervising the preparation of the bed, noting the bed height, and allowing a 30-min. soaking period after completion of charging, make a note of the maximum temperature reached by the instrument within 20 min. of the commencement of blowing the furnace.

2. Note the number of charges required on the bed to fill the cupola to thermocouple level.

3. At the end of the "blow," note the maximum temperature reached.

4. Record from time to time the physical conditions of the metal as tapped.

These figures should show agreement between the three tests, and reference to the charts produced during the test-runs and to the notes made at the same time should enable a temperature figure for the couples to be assessed at which it may be expected that hot metal will be melted. If this temperature agrees with the maximum temperature at the commencement of the blow it may be assumed that the bed is also at the correct height. On the other hand, should these temperatures differ widely and the metal is still cool after the third tap it is necessary to increase the initial bed height. A further run should be made to ascertain that the alteration made has been adequate. During this run the number of charges required to fill to the couple level must be recorded again.

Once the bed height has been satisfactorily established to give the conditions as recommended in the previous paragraph it is possible to estimate the weight of metal available during the blowing-down. During the test runs it will have been noted that the blowing-down temperature is exactly the same for each run and does not vary in any way when

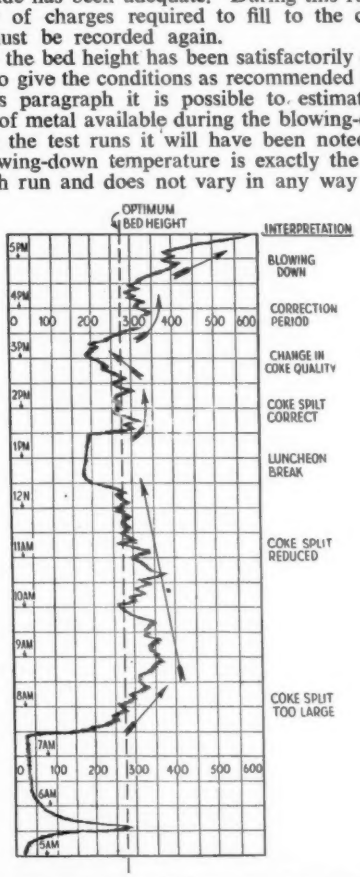

FIG. 3.—*Operating Record from the Cupola Thermocouple showing a Complete Day's Melting Cycle.*

the operating conditions change. Therefore, it is only necessary to produce a scale from zero, at the blowing-down, to the weight of metal obtained at charging-up to the couple-level in terms of degrees centigrade. The blowing-down follows a straight-line law therefore all the divisions are equal; this simplifies the making of the scale. An original scale made during a blow-down is shown in Fig. 2.

In order to make corrections during the course of a melt it is necessary also to calibrate at least a part of the temperature-scale into coke weights, so that the "splits" may be correctly added or adjusted in weight; this follows from the fact that the temperatures indicated are in relation to bed heights. Coke calibrations are made plus or minus from the "ideal" bed height, which is done by checking the volume of a normal charge excluding coke and limestone. A similar volume of coke is weighed, which is thus equivalent to a normal charge weight. On the temperature scale, calibrations have been made for blowing-down in terms of cwts., and it will not be found difficult to apply the coke equivalent figures to the temperature scale (see Fig. 2).

Instrument Control of the Cupola

Once the instrument has been calibrated as described and the "ideal" temperature estimated for the melting, it is possible to run the cupola entirely by the instrument. A little thought and experience enables any variation in the running of the cupola to be corrected before the metal is affected. The following notes show how this is done and how to recognize and correct the normal faults which are encountered.

Preparation of the Bed

When building the cupola bed, it is usual to use some measure such as an iron rod or a chain to which is attached a weight which can be lowered down the shaft until the correct bed height is reached. If this is not already a standard practice in all foundries, it is strongly recommended that it should be adopted. Furthermore, the bed should be blown through until the coke is incandescent to within 6 in. or so of the top; this will allow the bed to settle and at this stage, measurements should be made.

In blowing the bed through, it is found that if the meter indicates a little above "ideal," the conditions given in the earlier paragraphs are satisfied. Charging should then take place and be completed some 30 min. before commencing to blow the furnace. It should be noted that the correct bed height will already have been found as described under the heading "Calibration." Fig. 3 shows a typical cycle covering lighting and preparation of the bed and continuing with the full-day's run.

Initial Melting Period

When the blast is put on, the readings from the thermocouple will rise somewhat steeply and then level out, the rate of rise and maximum reached being an indication of the coke bed condition. Metal should be tapped directly the levelling out has taken place, in order to clear the cooler metal from the well. By this time, it will be known whether or not the bed height is correct and if not, a correction should be made as soon as possible. Reference to the calibration scales in terms of coke will enable a reading to be made of the amount of correction needed.

If the bed is low, the extra coke should be added as one large increment, but if it is high it is advisable to deduct the coke from the "splits" between the metal charges, so that full correction takes place over ½ to 1 hr. A small departure from the "ideal" may be tolerated and left uncorrected, but this is a matter for the operator to assess by experience.

After the first 15 min. of operation it may be noticed that the indicator is rising or falling,

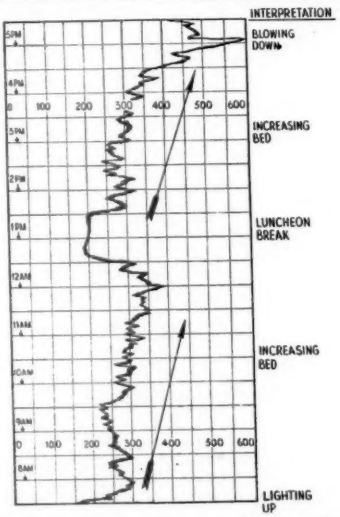

FIG. 4.—*Melt Record from the Cupola Pyrometer showing Effect of Increasing Bed Height throughout the Period.*

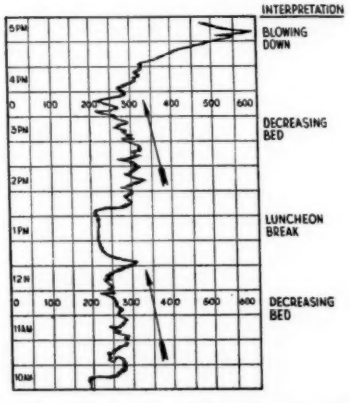

FIG. 5.—*Record showing the Effect of a Slightly Decreasing Bed Height on the Recorded Temperatures.*

Melting Control by Cupola Pyrometer

showing that the coke-ratio is too high or too low. The rate of rise or fall is the most useful information and, at the end of a 30-min. period, a check will show how much coke has been gained or lost; this figure can be divided amongst the charges put on during the same period, giving the net gain or loss per charge. Adjustment of the charge-coke weight by this figure will bring conditions back to normal.

If a gradual change be allowed to take place over a long period, it will be appreciated that a correction must also be made for the gain or loss of coke during that period and the correction of the charge-coke weight is only to arrest the change. Figs. 4 and 5 indicate the types of records obtained when the bed height is increasing and decreasing respectively.

Scaffolding

When scaffolding takes place, an indication is given by a rapid rise followed by a rapid fall of the indicator, the time in which this takes place indicates the extent of the scaffolding. The bed is sometimes lost during these events and a correction may be necessary.

In studying the charts it will have been noticed that the line plotted is not smooth but is stepped and also shows regular rises and falls. Each step shown represents a tap of metal from the cupola and the rises and falls correspond to the arrival of new charges to the melting zone.

Special Metal

Some foundries tackling a variety of work find it necessary to work in special charges during a "blow," and the writer has found the instrument invaluable to show when the special charges start to melt. The charging procedure is somewhat unorthodox but works well in practice and is therefore recommended. In order to obtain good results, the bed should be at the "ideal" value as determined by the apparatus or slightly below this figure. Charging is then stopped until the burden descends to the level of the thermocouple. At this point, a treble charge-split of coke is added, followed by the special-metal charges, each of which has a little less coke split than necessary, in such a way that the large split is consumed in melting the special charges. Following the special charges, normal charging may be resumed. As melting proceeds and the special charges reach the melting zone, the indicator will show a small rise due to the extra coke starting to ignite. On entering the melting zone, the ignited extra coke becomes incandescent and the extra heat available affects the indicator which will show a sudden appreciable rise of about one minute's duration. At this point, the special charges begin to melt.

Other Control Features

In describing the use of the instrument for cupola control, it may be realized that the instrument also serves to check that the cupola staff are following out a lighting procedure at the set times. Such a record is in itself useful and does much to make certain that the cupola will start off under ideal conditions. A further asset is that the instrument enables the minimum coke to be used consistent with good metal temperatures and enables compensation to be made for cokes of varying calorific values.

Although the instrument used by the writer is of the recording type, this is not essential for minute-to-minute control and the normal indicating type of pyrometer may be used to provide quite good results. Frequent observation is, however, necessary in employing such an instrument. The melting rate in relation to the maximum output of the cupola has not been mentioned, since the indicator is not thereby affected, but it is necessary to follow normal cupola practice when melting at high outputs by running slightly above "ideal" to keep the bed height up to the higher melting zone encountered at such times.

In concluding it is hoped that the publication of this information will enable those metallurgists interested in cupola control to instal equipment and derive as much benefit from its use as has the Author in his own foundry. The writer wishes to express his appreciation to the directors of the Suffolk Iron Foundry (1920) Limited for permission to publish this work and especially to Mr. Danielli who has shown special interest and given encouragement in the Author's endeavour to improve cupola practice.

Brazil's Iron and Steel Industry

Brazil's national steelworks, the Companhia Siderurgica Nacional, has declared a dividend of 10 per cent. on ordinary shares held by private investors, 7.5 per cent. on those held by the Treasury, and 6 per cent. on preferential shares, the total for distribution being £1,875,504.

The company's output in 1951 included:—Coke, 285,604 tons; pig-iron, 342,087 tons; steel ingots, 465,032 tons; rolled steel products, 342,561 tons. Its own mines yielded:—Coal, 224,213 tons; iron ore, 275,551 tons; manganese, 7,314 tons; dolomite, 24,820 tons; limestone, 52,195 tons. Including 531,596 tons of mineral, the plant consumed 1,211,572 tons of raw materials, or 3.5 tons per ton of rolled steel.

President Vargas has approved a project, submitted by the Brazil-U.S. Commission, to increase production of iron pipes for public water and drainage supplies by the Cia. Metalurgia Barbara from 15,000 tons to 25,000 tons annually. Imports last year cost Brazil £1,800,000 and domestic consumption is increasing owing to the expansion of sanitary services.

Anglo-Brazilian trade increased in both directions last year, exports to Brazil rising to £63,166,560 (c.i.f.) and imports from Brazil to £63,921,440 (f.o.b.). British vehicles accounted for £8,603,000, machinery and tools for £8,403,000, bicycles and motor cycles for £1,839,000 and tools for £1,171,000, iron and steel in bars, rods, etc., for £763,000. Great Britain supplied 15.1 per cent. of Brazil's imports of machinery, apparatus and tools, 15.1 per cent. of motor vehicles and 10.3 per cent. of iron and steel manufactures.

SPEAR & JACKSON, LIMITED—Mr. George William Parsons has resigned his position as technical director.

Time and Motion Study*

By C. D. Hunter

In competitive industry, the cost of making a product largely determines whether a plant prospers and remains on a sound financial footing or otherwise. This cost depends very considerably upon the amount of time taken in production and this in turn depends on the design of the component, the methods of manufacture employed, and the effectiveness of the tools and equipment provided. Attention to these fundamentals should ensure that the cost of making a given product is kept below the price at which it is saleable in a competitive market. That price is frequently established by competitors whose production times are similarly controlled. This Paper deals with the way in which proper times are established with particular reference to the Mueller Plan, and the Yale & Towne 100 per cent. allowed-hour incentive plan.

In a manufacturing organization, the control of the time of production of an article is the task of the methods and time-standards departments. The methods department—and in this is included the jig-and-tool drawing office—has the responsibility of establishing the best method of making any product, and the time-standards department that of the pre-determination of what the time shall be for each of the operations required.

Methods Department

Considering the methods department, one is very prone to look for spectacular methods of improvement—introduction of conveyors and the like—and forgets that day-by-day cultivation of good shop-practice really pays big dividends. In the Author's experience, by following the course of looking for obvious improvements, over 100 factories have increased production from 38 per cent. to 64 per cent.

To give but a few examples which come readily to the mind:—

Material handling.—Worthwhile economies can be introduced by the provision of well-designed skids conveniently located in respect of a machine or operator having the next "job on" available before the first is completed, and the provision of work containers, suitably designed to preserve finished surfaces during transport. This approach is not confined to machine-shops or machining operations. Take the coreshop for example—can two operators produce on the same machine effectively? Three coreboxes not necessarily for the same core can be circulated between two people with an increase in machine efficiency of, say, 150 per cent., and an operator increase in effectiveness of 25 per cent.

The provisioning of sand, cores and moulding boxes, at the right time and in the correct condition and quantity can improve production by 15 per cent. Improvements in handling in the fettling-shop and service to the operator which can be effected by the correct approach with the right attitude of mind are worthy of the utmost consideration. The arrangement of heavy plaster patterns in suitable racks arranged for accommodating them on end can facilitate the production programme and inspection of the pattern to ensure that each is available for production in good condition at the time planned.

In many foundry plants, the patternmaker or mould designer (in the case of die-casting practice) decide to a large degree the method to be followed in moulding. Nevertheless, if one man is made available—even in a small jobbing foundry—to apply himself to this approach then in future it will not be "Can we afford him?" but rather—"Can we do without him?"

Machine-shop Practice

The standardization of cutting-tool practices in the machine-shop is of paramount importance and the shape, form and rigidity of the tool should be clearly defined at the tool-design stage. Re-grinding of tools should be executed in the tool crib so that uniformity of practice may be maintained. This is particularly important with tungsten-carbide tipped tool applications. With metal cutting it is common to find similar parts being cut at different feeds, the same kind of materials being machined at varying speeds, left- and right-hand parts of the same design being processed with cutters of different diameters. Existing cutters should be viewed to obtain maximum efficiency consistent with economic tool life between tool re-grinds, and the results thus obtained should then be standardized for all future similar conditions.

Setting up, whilst normally occupying a small proportion of the total shop operating-time and, therefore, not receiving all the attention merited, is a field in which considerable savings can be made by:—(*a*) Setting tools to a master component, particularly in connection with automatics and other multi-tool machines; (*b*) minimizing the number of clamps used in connection with fixtures, whilst maintaining rigidity (the use of uniform spanner-size should receive special care); and (*c*) by inserting interchangeable jaws into standard work-holding fixtures semi-permanently attached to the machine. Tool engineers of the methods engineering section can be of considerable help in this connection if they design fixtures which are easy to clean—or indeed are self-cleaning, by provision

* Paper presented at the Brassfoundry Productivity Conference at Harrogate. The Author is director, Stevenson, Jordan & Harrison Limited.

being made for the falling away of chips, swarf and lubricant. The correct placing of clamps can reduce the idle time of cutters to an important degree. When handling parts weighing 50 lb. or over, suitable hoisting arrangements should be made.

Standard Data

Standard data should be available to the methods department so that standardized tooling practice can be developed and the best methods of operation devised within the budget of tool expenditure and consistent with the quantity and quality of components to be produced. The job of providing time-standard data rests with the time-study department. Their job is one of investigation and analysis and their duty is to compile synthetic data and production standards which form the basis upon which good management may be built with confidence. In the end result, this data may be embodied into a sound incentive plan. Success with incentive plans is more dependent on management's planning than on the work of the factory personnel. A well-thought-out plan of incentives rewards operators for co-operating with management's pre-planning. Management in this concept embraces all supervisory executives and most important of all, that very worthy individual, the foreman.

Size of Incentive Groups

Individual incentive applications are the best and should be used wherever possible. The operator can then see the direct effect of his own efforts in relation to his earnings. There are conditions where the work of one operator cannot be isolated, where for example the task is of such a physical size that two or more men are required to accomplish it. Further, an operator may be one of a production line where the pace of production is determined by the rate of flow along the line and where a given worker can do no more pieces than the number which flow down the line past him. In these cases, group incentive payments are created, in which all members of the group share alike in the rewards for their co-operative effort.

Time Standards

The Yale-Towne 100 per cent. allowed-hour incentive plan is purely one applied to a particular company which has been given a special title to differentiate from the particular piece-work plan which was in operation previously. It is, in fact, nothing more or less than the standard practice of the Author's company in the United States of America, Canada and in Great Britain and indeed in many other parts of the world. The important point to be borne in mind, when considering the practices adopted, is that jobs or complete operations are not timed except in very unusual or extreme cases. The object is to compile, through time-study observation, elemental time data and create a standard book of reference of such data.

When a new component is to be manufactured, it is first broken down into operations as may be determined by the methods department, then each operation is broken down into elements as may be envisaged by the rate setter of the time-study department and, by reference to a standard data manual, times may be allocated against each element so determined. By adding these elemental times together it is quite apparent that the time for the whole operation is obtained.

Elemental Times

It is quite evident that extreme care and attention to detail must be given in the compilation of the elemental times contained in the book of reference data. The first essential is to have a complete and carefully-compiled specification of every item of equipment and machinery in the plant, clearly defining capacity, speed and feeds and all relevant technical details. In the Author's experience, many companies already have such data, very often excellently compiled and in extreme detail. It is, nevertheless, also the Author's experience that much of this data is not being kept up to date and in consequence, where checks have been taken, the data has been found incorrect to an extent of at least 50 per cent. Such data should be kept up to date by a modification procedure and as adjustments to machines or equipment take place, this must be reported faithfully to the standards department.

Time-study

The first essential procedure in setting time-standards is the medium of time-study. Time-study is a general term which covers the whole field of getting facts about how work is done, and how long it takes. Any study is a combination of a complete report on the work any operator performs and the time the operator takes to perform each element of the work. Hence time-study is a procedure for collecting data. For studies to yield correct time values for the elements of work, it is necessary that a true cross-section of shop operations and workers should be studied.

In establishing elemental data as many operators as possible are timed. Because it is not possible for one man, in a reasonable period of time, to make enough studies, it is customary for the study work to be divided up; this means that different time-study observers will study similar operations. In many cases these are the firm's own observers, company-selected personnel trained by the Author's firm or, on occasion, union representatives who have also received the benefit of training in the methods.

This has the additional advantage that the company has not only established a section or department trained in the particular methods of approach and techniques in application, but also has engendered confidence in the application of standard synthetic data to new jobs, by virtue of the training of union representatives in the fundamentally sound derivation of original data from which such synthetic or standard data is established. It means that different time-study observers will study similar operations and these studies will

be brought together by a time-study analyst, it being very important that the studies all be taken exactly alike. The work-place, the machine and the work done in every case should be faithfully recorded.

Elemental Analysis

Every operation consists of one or more integral units which are called "elements." Each element is a separate entity, subject to its own particular causes of variation, and before commencing the recording of time for an operation, the observer has to decide upon his elements. This is no arbitrary decision. The precise nature of the elements is determined by the factors which govern the successive steps of the operation. Some phases of the work are unaffected by job conditions, and for them a constant elemental time-value can be computed; others are found to be influenced by a varying dimensional factor such as weight, size, length, or shape, and in those cases the time is graphed against the particular cause of variation. As an illustration of elemental analysis, consider capstan lathe operation; here, there are two distinct types of element—the lever movements, which are constant and unaffected by the tooling or the component, and the machining, which varies according to the type, size, and material of the cutter, the length, diameter and material of the component, the speed and feed of the machine, and the quality requirements.

Recording the Time-study

The document of major importance in the standards department is the observation sheet or time-study sheet. On this form is recorded all the relevant data concerning an operation, and the object is to secure a complete exact record of the work required to perform the operation, the actual time taken, and all circumstances relating to the work. The instruments employed are a decimal-type minute-watch and a study board. On occasion a time-study machine is used.

The approach to the operator is made through the foreman, and the operator is kept fully informed as to what is taking place. His interest is sought and his questions answered, and every attempt is made to secure his co-operation. The observer takes up a position from which he can clearly see all the operator's movements, and in which he can be seen by the operator. When the observer has noted on his study sheet all the relevant identifying information concerning the operation, and recorded a detailed description of each element, he starts the watch and records the watch reading at the completion of the element. Extreme accuracy is imperative in defining the elements, and it is important to give an elemental description which leaves no possible doubt as to where one element finishes and the next one commences. The break point should be clearly defined by a visual movement or, in certain cases, by sound—for example, the impact of the part as it falls into the stock box. The study should be long enough to give a complete picture of the cyclic elements (those which occur regularly per work cycle) and the non-cyclic work in the operation (the elements which occur infrequently, such as the removal of slugs after pierce and blank). Apart from the cyclic and non-cyclic elements, the study may contain certain interference factors such as "material dropped," "personal needs." These are recorded as they occur, and separated from the normal work factors when the study is extended.

Having finished the time-study, the observer notes on his study sheet all information which can possibly affect the operation—*e.g.* length, diameter and thickness of material machined, type and size of cutting tool, speed, feed, thickness of metal removed, type of material for the component, type of tool-steel and tolerances required. A sketch of the operation, the path which the component follows, and the layout of the work station can with advantage be added.

In fact the finished study constitutes a complete history of all that occurred during the course of the observation, and the observer obtains a complete, concise, clear picture of all circumstances and conditions relating to the job timed, as well as all information necessary for a sound analysis.

Operator Performance Rating

The object of rating is to establish a time for a normal operator working in normal conditions. During the course of a time-study, the observer assesses the performance of the operator element by element and records the rating alongside the observed time. No two persons perform a given task at the same rate of working, nor does an individual work at the same speed continuously, and the observer's attention is therefore concentrated upon the operator's proficiency and effort throughout the study. It will be appreciated that accurate rating, which is of the greatest importance, can only be achieved by the observer after considerable practice and experience; no text-book or lecture can teach him to differentiate between one rating and another so as to give a constant answer in basic time for various observations on the same element.

It is the Author's usual custom to relate ratings to a base of 100, so that 100 per cent. represents normal performance and the rating factor indicates the observer's evaluation of the operator's performance expressed as a percentage above or below that figure. When an observer finds an unusually proficient and dexterous performance, obviously above normal, he gives it a rating above the normal 100 per cent.; a hesitant and intermittent performance must be rated below 100 per cent.

Analysis of Elemental Time

When the observer leaves the shop after taking a time-study, his study-sheet contains details of the operation, element by element, with the cumulative readings from his stop-watch and, in addition, the corresponding rating factors. The next step is the normalizing of the times, which is largely a clerical function. The accumulated times are converted into net actual times by subtraction, and for each element the observed time is obtained. The observed

time and rating for the element are multiplied together, and the product is divided by 100 to give the basic elemental time. This basic time is the observer's assessment of the time a normal operator should take to perform the work involved in the element when the job conditions are standard as recorded on the time-study. The times thus normalized for an element are analyzed for the frequency with which they occur, and the ideal selection is the time which occurs most frequently and which has the same number of readings above as below it. The range and fluctuation of the times reflect the consistency of the operator, and the better the demonstration the more accurate the selection will be.

In connection with this selection of elemental observed time, it is important to note that all the readings listed for selection must be truly comparable. High readings which include non-standard interference factors or low readings for incomplete elements should have been clearly indicated as non-standard on the study, so that they can be excluded from elemental time analysis. A sound selection cannot be made from a number of readings for different conditions, and to attempt to correlate variables in this way is to abrogate the principles of time-study. As previously stated, many time-studies are taken by different observers on various operators before standard times can be computed. The posting sheet is a master table of these studies, so arranged that comparison may be made readily of basic times for the same element in various conditions. By summarizing the pertinent information in this way, it is possible to see the complete picture without constant reference to the individual time-studies.

The tabulation of study results tests the adequacy of the time-study technique and reveals the sufficiency of the data that have been recorded. All the basic times entered on the posting sheet are selections for a particular element from time-studies, and by means of this sheet it is possible to make the final selection in basic time per occasion. For the constant elements, this is done in tabular form, for the variable elements the times are graphed against the causes of variation, so that for any given set of conditions the corresponding elemental basic time per occasion can be obtained. A permanent curve is built up progressively, and study-work is planned so that extremes of the range are covered with the result that although study-work is intensive whilst the standard data are being prepared, it is only a fraction of the amount which would be required if no synthetic procedure were adopted.

Standards Computation

When, for a given set of operations, the basic time has been selected for the constant elements, and the graphs completed for the variable elements, it is possible to establish the production standards for all existing operations, and to compute production standards for any given new component.

Proving the Standards.—After the "synthetics" have been compiled, they are proved by means of a series of all-day production studies on selected jobs covering the complete range. These production studies may reveal a small proportion of ancillary work such as swarf removal, changeover, and other incidentals which are too infrequent to justify inclusion with the normal elements. For this work, a comprehensive addition is made to the total basic time for the operation in the form of an allowance according to individual requirements.

Standard Allowance.—The total basic time for an operation takes into account all the conditions, but from the point of view of the operator there are certain other factors to be considered. The first of these factors is fatigue. This is a variable, and the extent of the allowance given varies according to the particular job. Points for consideration in assessing fatigue allowance are working position, length of operation cycle, size and weight of work handled and such working conditions as noise, smell, heat and cold. The second factor is operator personal needs for which a constant allowance is given. Finally the operator must be compensated by a constant time-allowance for loss of productive time due to tea-breaks, washing time and other amenities as determined by the management.

To determine an accurate allowance for such intangible factors as monotony or eye-strain is clearly difficult, but, by means of production studies taken over many years, it has been possible to determine in some measure the gradual effect of fatigue on an operator's productivity and to arrive at a compensatory allowance. When the basic time has been increased by the addition of these standard allowances the answer is described as the normal time—*i.e.* the time it would take a normal operator to perform the operation under the conditions specified.

Incentive Allowance

The incentive allowance in terms of time is one given to the operator for achieving normal time. The extent of this allowance is a matter for arrangement and agreement between management and operator representatives. Normal time plus incentive allowance equals standard time. To facilitate calculation, the time is generally issued in "standard hours per 100 components."

The standards computation sheet is the official document authorizing the issue of production standards to production departments, cost office, production control office, planning office and estimating section. Times can be issued to these departments individually, collectively or through the medium of pre-printed paper-work, but so far as the operator is concerned a copy of each standards computation sheet is always available for reference, to ensure that the method employed follows exactly the method for which the production standard has been established.

Industrial Applications

Imagine now the possibilities that this technique and method of compilation of production standards presents on an industrial basis. Within a given industry, it is possible to compile a library of information to be lodged with a centralized authority

covering all the standard conditions which obtain within that industry if some 8 or 12 representative companies are covered. All that is then required when approaching a new assignment within that industry is to check back for local conditions. For example, imagine that one has the time for such basic elements of work as placing the moulding boxes, the setting of the pattern in the moulding box, the loading of the moulding box with sand, the placing of the facing sand and so forth for a wide range and size of moulding box and pattern. Timing of these again should not be required unless some local conditions arose which might be different from normal. Such local conditions could be due to poor lay-out, or poor condition of pattern requiring more than the normal amount of patching of breaks in the mould. With these conditions brought up to the normal of those obtaining throughout the industry, the standard data could then be applied with confidence.

Further, the contentious point regarding rating disappears, for, if the original work is carried out to the magnitude indicated, a sufficiency of data will be recorded, in the first instance, to be able to discard indiscriminately all performances not conforming to standard or 100 per cent.

Production Standards and Managerial Control

Considering the question " What is produced in a factory? " Is it a multifarious conglomeration of bits and pieces used in all walks of life or are all producing one thing—that is, hours of work? Once production standards have been compiled for a section of operations by the synthetic procedure described, the management has more than merely a set of times, it has a flexible system for controlling production in all its facets. So far as the shop is concerned, the job of supervision is simplified to the extent that the standard output figures provide a measure of operator efficiency. If full allowance is made for all interference factors, the operators have an equal opportunity of increasing earnings.

Before an incentive scheme is introduced into a section, it is imperative that the operators concerned be called together and given a detailed explanation of their new wages payment plan. The basis of this may or may not have been determined by job evaluation. Job evaluation as a medium for the determination of the basic wages rate should be strongly recommended as it seeks to establish correct differentials between the various types of job in a factory. This type of plan and clearly drafted conditions of employment and agreement as depicted in the Mueller plan serve to ensure happy and beneficial worker/management relations. Moreover, when the scheme is operating, it is essential to keep the workers fully informed as to their progress. Daily results should be compiled for the first few weeks, until the section is completely familiar with the scheme, and after that weekly results should be made available.

For the cost accountant, the production standards provide a reliable basis for flexible budgets and cost control. Having used them to establish standard operating expenses, he can calculate and investigate the actual variations from standard and make this information available to the management. The principal causes of direct labour variations are:—

(*a*) Fluctuations in operator performance above or below standard. These are depicted on the weekly performance analysis, which shows a break-down of the hours worked, the hours earned, the efficiencies and the interference factors.

(*b*) Lost time. When an operator is officially idle, a lost-time card is made out, showing the time lost and its cause. By analysing these cards, a detailed statement for the management can be prepared showing the extent and cost of lost time for the various causes enumerated and so enable corrective action to be taken.

(*c*) Extra allowances. The standard time is given for a corresponding standard method, and where extra work has to be done by an operator because of some non-standard condition, faulty equipment, inadequate tooling or hard material, an extra allowance is issued by the time-study observer to give the operator the necessary additional time. Here, too, an analysis of extra allowances may be prepared to enable the management to take remedial action.

It is possible, of course, to operate cost-control without time-study, but both the establishment of the costing standards and the analysis of variations from standard are facilitated and made accurate when time-study data are available. In the same way, it is not " essential " to consider time-study data when designing tools, jigs and fixtures and planning methods of manufacture, but production planning will not make its full contribution to the profit potential which is so valuable to a manufacturing organization unless it takes into account not only the effectiveness but also the economy of the tools and methods employed.

Conclusion

In conclusion, time-study depends for its effectiveness upon a fair and honest approach by manager and operator. Every care is taken to ensure that the production standards are adequate, and it is the duty of management to bring the shop efficiency in line with the labour efficiency by a vigilant attack on the interference factors. In a well-run shop, the greatest benefits of time-study are derived from the control it provides, rather than from the incentive scheme. The application of time-study to a manufacturing organization *compels* management to *manage*, and that is perhaps its greatest contribution to the future industrial prosperity of our country and the welfare of our people.

THE T. & J. FOUNDRY, LIMITED, announce that, as from August 25, and coinciding with the works annual holiday fortnight, the Company will be merged with their associate company, Idoson Motor Cylinder Company in new foundry premises at Tividale. The new address will be at Dudley Road (corner of Hainge Road), Tividale, Tipton, Staffs.

Shell-moulding Process

The following comments are from an editorial printed in the *American Foundryman* and refer to the position in America:—

The question of whether the basic processes of shell moulding are in the public domain seems to be clearing rapidly as more and more foundries disclose their shell-moulding activities and recently-issued government bulletins help to clear the air. While some 100 foundries are estimated to be producing shell-mould castings, some in high production since 1950, the patent picture hitherto has been obscure because no one knows whether patents are still pending or have been denied. None has been granted, however, and shell mould producers are safe from infringement up to the time a U.S. patent claim is upheld.

The shell-moulding or "C" process was developed in Germany by Johannes Croning and was in use there as early as June, 1944. W. W. McCulloch, of American Cast Iron Pipe Company, Birmingham, Ala., working on a U.S. technical intelligence team, located and interviewed Herr Croning on April 24 and 25, 1947. His report, F.I.A.T. Final Report No. 1168, dated May 30, 1947, made the process available to the Allies. All processes employed by Germany during World War II and up until January 1, 1946, were considered to be in the public domain, available to industry, and not patentable in the United States or any other allied nation.

Croning filed applications for U.S. patents on December 3, 1947, and an estimated several-hundred patents for refinements are believed to have been applied for during the last five years by U.S. foundrymen.

According to U.S. Department of Commerce bulletin IR-7734, referring to the Croning applications: "The policy of the U.S. Patent Office does not permit the release of either technical details or disposition of applications for patent. Since no patents have been granted on either of these applications they may be still pending, they may have been abandoned, or they may have been finally rejected.

"The declaration that the process as disclosed in the German patent application (filed by Croning in the German patent office February 1, 1944) is in the public domain saves any user from liability for infringement. Naturally, if a U.S. patent, or patents, should be granted on *specific improvements,* an industrial user must not employ such improvements without obtaining a licence from the patent holder.

"Normally, a patent comes into effect on the date of issue. Therefore, in the absence of special contract obligations, a company which uses a variation of the process which is later claimed in valid U.S. patent, is not charged with infringement for the use prior to the date of issue."

Shell moulding appears to be ready for broad use in the industry. A number of foundries have been producing shell-mould castings for several years. Equipment manufacturers and resin producers have been working closely with the pioneers in mechanization of shell-moulding. A new tool for production of precise, smooth castings requiring a minimum of machining appears to be ready for mass use by the industry.

ABOUT 2,500 commercial and industrial undertakings in the north are being advised to reduce their electricity demands by 10 per cent. each day between 8 a.m. and 12 noon and 4 p.m. and 5.30 p.m. from November 17 to February 13. Last year there were no severe electric power cuts in the northern region due to the co-operation of firms in staggering working hours to transfer as much electricity load as possible from peak periods.

S.B.A.C. Exhibit

At the Society of British Aircraft Constructors' Exhibition, at Farnborough, September 1 to 7, David Brown & Sons (Huddersfield) Limited, on Stand No. 159, are to show a comprehensive range of intricate high-tensile and special alloy castings produced for gas-turbines and for highly-stressed airframe components. Typical examples of heat-resisting alloys developed by this company for extensive use in the centrifugally cast form are included in a selection of turbine shroud rings shown in this illustration. Relatively light sections are involved in all the castings shown, which exemplify the advantages of the centrifugal-casting technique. The metallurgical demands of such components are of interest in so far as the operating temperature is in the range of from 650 to 900 deg. C. In addition to providing relatively high strength at these temperatures, the dimensional stability, gas tightness, resistance to scaling, and machinability are important requirements.

FIG. 1.—*Selection of Gas-turbine Components Cast in Heat-resisting Steel by the David Brown Foundries Company.*

Works Managers' Conference

Lord Braintree, president of the Institution of Works Managers, Sir Walter Monckton, Minister of Labour, and a number of well-known industrialists and specialists in management technique are to address the conference of the Institution which opens in Birmingham on October 18. One of the subjects which is to come up for discussion is the suggested formation of some form of British productivity council, and members will be given information about steps already taken in the Midlands towards the foundation of joint study groups to collect, analyse and disseminate data about up-to-date production techniques. Mr. W. R. P. King, works manager of The Mint, Birmingham, Limited, and a prominent Midland member of the Institution, is to speak on this topic and he will tell members how, in 1951, Midland industrialists formed study groups to visit the factories of firms known to be practising modern production methods, after which the groups critically discussed these methods. There are now 35 managers taking part in the study groups and a new programme of visits for the autumn session is about to begin. Midland representatives will recommend that the formation of similar groups in other regions would be advisable.

Strength, Structure and Composition of Unalloyed Grey Iron*

By H. T. Angus, Ph.D., M.Sc.

Of recent years, a good deal of work has been published relating the composition to the strength and properties of cast irons, particularly in Europe and America. The most recent of these to be published in the Proceedings of the Institute of British Foundrymen was that by Laplanche[1] in 1948, and this dealt mainly with structure. No recent paper has been published by the Institute dealing in detail with both mechanical properties and structures in a manner of practical daily use to foundrymen.

The theoretical basis and the detailed experimental results that form the foundation of this Paper were published in America[2] and in this country[3] in 1949. It is not proposed here to give a detailed account of the theoretical principles involved, but rather to present an orderly summary of existing knowledge in such a manner that the foundryman can make ready use of it in his day-to-day work.

The basis upon which the following discussion is to be made is the carbon-equivalent value:

$$\text{C.E.} = \text{T.C.} + \frac{\text{Si} + \text{P}}{3}$$

This formula is an expression of the effect of silicon and phosphorus in lowering the carbon eutectic figure by approximately 0.3 per cent. for each 1 per cent. of silicon and phosphorus that is present. Only unalloyed and non-inoculated irons are considered. The results are based on independently-cast test-bars, cast in green sand.

Tensile Strength

The characteristic mechanical properties of cast iron are largely dependent upon the amount of graphite present, and as the composition of the iron with relation to the eutectic value to some extent controls the amount of free graphite that is present in a casting, an expression of this type may be expected to give some indication of the mechanical strength of the iron. The papers mentioned earlier[2,3] have shown this to be the case and, although there is quite a substantial scatter in the results, it is possible to predict with some degree of certainty the probable tensile strength that may be expected from a given composition in a given test-bar. Fig. 1 (0.875 in. dia. bar) shows the order of scatter to be expected when graphically representing the tensile strength against composition on a standard 0.875 in. dia. bar, and as a result of a considerable number of test figures, it is possible to draw a series of curves relating the probable tensile strength obtainable for all five British Standard test-bars in relation to their composition as determined by the carbon equivalent value (Fig. 2).

When examining these curves, it is important to remember that each line is the centre of a band of uncertainty of about ± 1½ tons per sq. in. wide, so that appreciable overlapping is likely to occur, particularly in the bars of heavier section. In this curve, the lines are shown slightly divergent. This divergency appears to fit the results obtained from British practice. Schneidewind and McElwee,[4] however, show a series of parallel lines based not only on their own results but also on results collected from the literature, and it is only fair to say that the difference involved in these two presentations

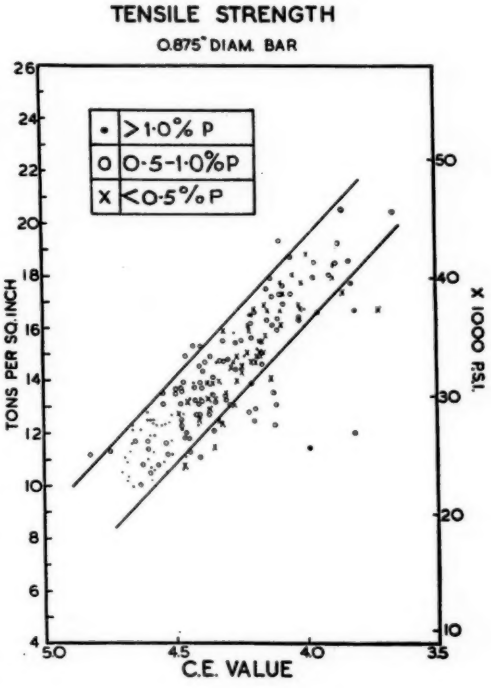

FIG. 1.—*Distribution for 0.875-in. dia. Bars of Low, Medium, and High-phosphorus irons in the Strength/Carbon-equivalent Curve when plotted to the Formula* $\text{C.E.} = \text{T.C.} + \frac{\text{Si} + \text{P}}{3}$.

* Paper presented at the Buxton Conference of the Institute of British Foundrymen.

is within the order of experimental error. The Author has chosen to accept the diverging lines since they actually conform slightly more closely to the results that have been obtained in British foundries, but the width of the scatter bands makes the distinction a little artificial.

Transverse Strength

A similar series of curves can also be drawn for the transverse strength. As would be expected, the scatter is wider than with the tensile bars, partly because the determination is carried out on unmachined bars, and partly because the actual figures themselves are substantially higher than the

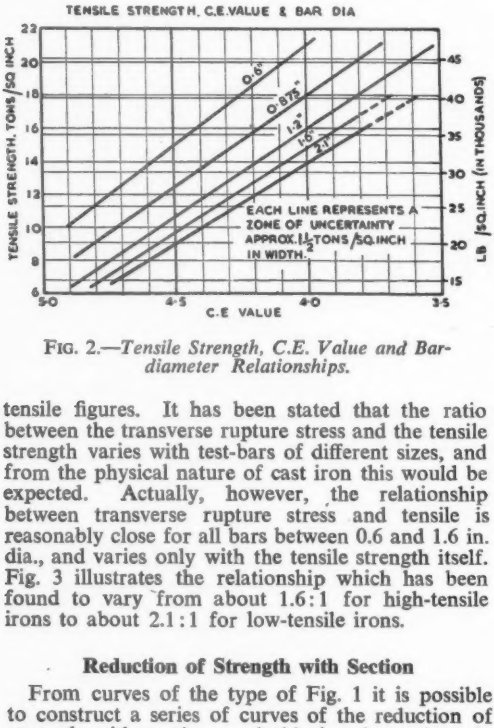

FIG. 2.—*Tensile Strength, C.E. Value and Bar-diameter Relationships.*

tensile figures. It has been stated that the ratio between the transverse rupture stress and the tensile strength varies with test-bars of different sizes, and from the physical nature of cast iron this would be expected. Actually, however, the relationship between transverse rupture stress and tensile is reasonably close for all bars between 0.6 and 1.6 in. dia., and varies only with the tensile strength itself. Fig. 3 illustrates the relationship which has been found to vary from about 1.6:1 for high-tensile irons to about 2.1:1 for low-tensile irons.

Reduction of Strength with Section

From curves of the type of Fig. 1 it is possible to construct a series of curves of the reduction of strength with section, and this has been done in Fig. 4 for five of the irons which meet British Standard Specification 1452/1948. Curves of this type have frequently been published before and confirm, in general, the results shown here. Again, it is important to realize that each of these curves is the centre of a band of uncertainty of considerable width, and it is always easy to find cases where the strength of various bars from the same ladle does not conform exactly to the range shown in the figure. Irons with total carbon below about 3.3

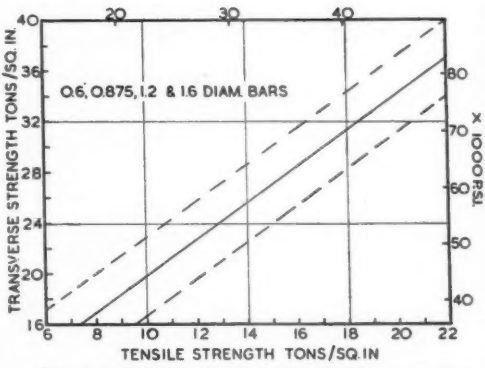

FIG. 3.—*Relation between Tensile Strength and Transverse Rupture Stress for Bars varying from 0.6 to 1.6 in. dia.*

per cent. are likely to fall on or above the centre-line and irons with total carbon above 3.5 per cent. are likely to fall below the line. Nevertheless, these figures may well be taken as representing those likely to be obtained with test-bars cast in green-sand moulds.

Hardness

It is important to realize that although the properties referred to previously do bear some relation to the composition as expressed by the carbon-equivalent value, no such simple relationship can be adduced for the Brinell hardness figure. Thus, Collaud[5] has quoted tests in which a hardness of 200 Brinell corresponds with tensiles from 12.7 to 18.4 tons per sq. in., while Mackenzie has published a curve showing the range of hardness to be expected with irons of different strength (Fig. 5), and from these figures it will be seen that the scatter in hardness, particularly at the higher-tensile ranges, is very wide indeed, and for this reason hardness figures should be employed with very great care in specifications including strength. Phosphorus is one of the elements which produces a very large varia-

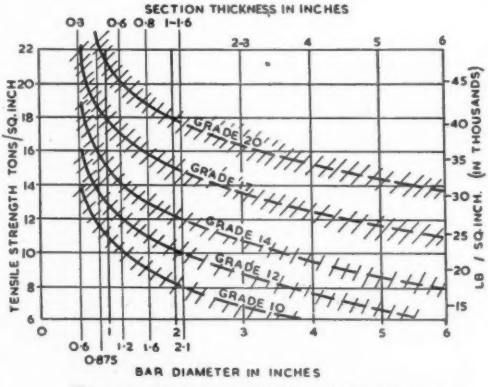

FIG. 4.—*Section Sensitivity of Cast Iron.*

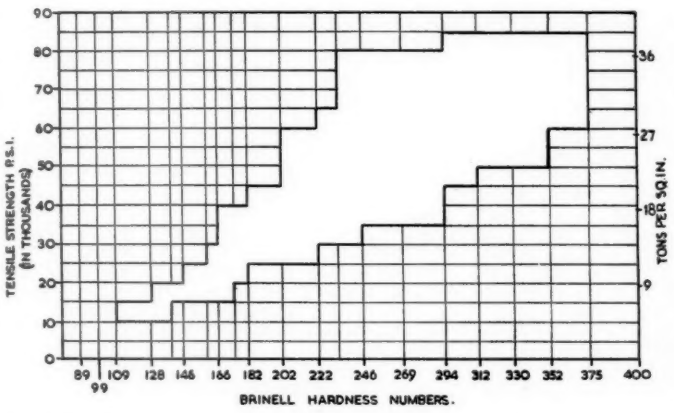
TENSILE STRENGTH P.S.I. (IN THOUSANDS)
TONS PER SQ. IN.
BRINELL HARDNESS NUMBERS.
89 99 109 128 146 166 182 202 222 246 269 294 312 330 352 375 400
36
27
18
9

FIG. 5.—*Scatter Range of Brinell Hardness* versus *Tensile Strength.*

tion in hardness irrespective of its effect on strength. It has been stated that an increase of 1 per cent. phosphorus raises the hardness of a casting by some 40 points Brinell. The form and amount of the graphitic carbon also have a very marked influence, as also does the degree of sub-division of the pearlite. For this reason, any attempt to specify hardness together with other properties must be done with a full knowledge of the composition likely to be employed, the size of the casting to be tested, and the position at which the hardness test is to be taken.

Nevertheless, for closely defined conditions the hardness figure can bear a relationship to the tensile strength. Dübi[7] and Collaud[5] have published papers which show quite clearly that for a series of test-bars cast from the same ladle as the casting itself, the hardness of a tensile test-bar may be the same as the hardness of a portion of that casting with the same tensile strength as the original bar. If, therefore, from the results of two or three test-bars, the curve relating Brinell and tensile strength be constructed, it may be possible, by taking hardnesses at various points of the casting, to determine the tensile strength of the casting at the point at which the hardness-test was carried out. Jungbluth[8] has shown, however, that the relationship is not always very exact, and there is little doubt that it can only hold good when the basic microstructure of the bars and casting at points of similar hardness are the same. Another limitation of this method is that as the hardness in the centre of a heavy section cannot be taken without destroying the casting, so the tensile strength at this point cannot be determined except inferentially by means of curves of the type shown in Fig. 4.

Shock Resistance

The resistance of an iron to mechanical shock bears no relation to the carbon equivalent value. For low-phosphorus irons, shock resistance increases generally with tensile strength. Increasing the phosphorus content, however, lowers the shock resistance even where similar tensile strength is obtained.

RELATIONSHIP BETWEEN COMPOSITION AND STRUCTURE

Many efforts have been made to determine the relationship between composition and structure, and as an outline of the various schemes suggested has been published,[1 2] it is not proposed to go over the ground previously covered in these papers. The foundryman is particularly concerned in producing (or avoiding) three main types of structure:

(*a*) Soft irons containing appreciable amounts of free ferrite as well as pearlite;

(*b*) strong, machinable grey irons containing pearlite, but no free ferrite or free carbide, and

(*c*) mottled, chilled or white irons which are hard and virtually unmachinable.

Each one of these categories is desirable in its own place and may be equally undesirable if found in the wrong place. For example, a soft ferrite-bearing iron is regarded as unsatisfactory under conditions of lubricated wear and scuffing, and a mottled or chilled edge is undesirable in a casting required to be machinable.

The difficulty in devising a simple means of determining into which group a particular iron will fall when used in a casting is due to the many variables that affect the microstructure. In the past, for example, it has been customary to regard silicon as the most important element affecting chill, and to some extent this is correct, but the total carbon and the phosphorus each has a positive effect upon the chilling tendency of an iron. The section size of a casting is another difficult variable to evaluate, and it is possible for iron from the same ladle to produce a soft ferrite-bearing casting, a strong pearlitic but machinable casting, or a white or mottled unmachinable casting, depending upon the section into which it is poured.

Types Defined

In order to make even an approximate attempt to evaluate these variables they must be simplified, and the two most useful simplifications in the Author's experience are the series of diagrams first proposed by Uhlitzsch and Weichelt[9] (Fig. 6) and the figure put forward by Sipp and modified by Angus, Dunn and Marles[2 3] (Fig. 7) which was based upon the microstructure shown in Figs. 8 to 12:

Type I shows ferrite associated with normal flake graphite in a pearlitic matrix.

Type II shows ferrite associated with undercooled graphite in a pearlitic matrix.

Type III is entirely pearlitic.

Type IV (*a*) shows the initial formation of carbide in conjunction with phosphide eutectic.

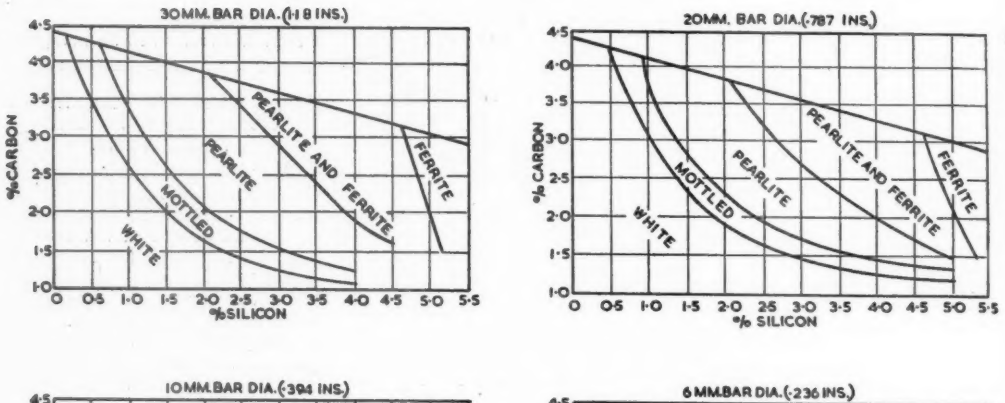

FIG. 6.—*Structure Diagrams by Uhlitzsch and Weichelt for Relating Composition and Section.*

Type IV (*b*) shows a more extensive formation of carbide.

Type V shows white iron.

It has been necessary to differentiate between type-I and type-II ferrites, as the former is usually associated with slow and medium cooling rates and the latter with high cooling rates. It is fully appreciated that the tendency to form one or other of these two types of graphite/ferrite structure is dependent upon factors other than cooling rate, but under normal melting conditions the undercooled variety of graphite tends to predominate in thin sections and is quite distinct in its formation from that produced in conjunction with normal graphite at slower cooling rates.

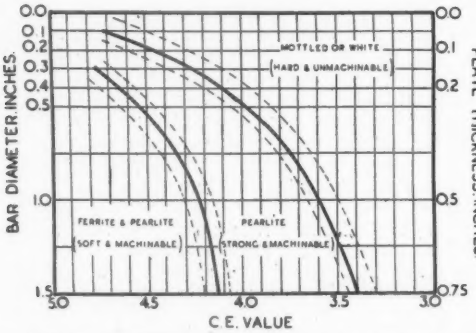

FIG. 7.—*Diagram by Angus, Dunn and Marles relating Section Size, C.E. Value and Structure.*

Type III, which is fully pearlitic, is the structure aimed at in the majority of engineering castings requiring strength, resistance to wear under lubricated conditions and good machinability.

Type IV (*a*) illustrates the transition from a pearlitic iron to a mottled iron. If any phosphide is present, free carbide begins to form in conjunction with the phosphide eutectic and the margin may be a narrow one between this stage and that shown in type IV (*b*) which is normally regarded as unmachinable. In a low-phosphorus iron, type IV (*a*) would have a hardness of about 240-260 Brinell, *i.e.*, about the limit used by Sipp; type IV (*b*) would have a hardness in excess of 280 to 300 Brinell. Type V is entirely white.

Effect of Phosphorus

The paper by Uhlitzsch and Weichelt merely considers the elements carbon and silicon and provides four diagrams, each dealing with a specific bar diameter. The basis for the structure is primarily that of fracture and hardness, and this constitutes one of the differences between this diagram and that of Angus, Dunn and Marles. The original diagram of Sipp considered only the effect of carbon and silicon in relation to section, ignoring the effect of phosphorus, and the determination of structure was

based solely upon hardness determinations. The modified diagram by Angus, Dunn and Marles takes phosphorus into consideration by utilizing the carbon-equivalent value, and the structures are determined microscopically. It is partly on account of the different method by which structure is determined that some of the variation between the two diagrams occurs. In both diagrams, manganese above about 0.6 per cent. is likely to retain pearlite in irons that might otherwise contain ferrite. Cold pouring may also increase the tendency to produce type-II ferrite, particularly near the surface of a casting. Discrepancies can occur on the mottled side of the diagrams, due to the fact that visible chill is taken as the index for the mottled area in the first series of diagrams, and microscopic chill, or ternary phosphide eutectic (Fig. 11(*a*)) in the second diagram. The formation of microscopic chill is definitely affected by the presence of both phosphorus and silicon. Visible chill, however, undoubtedly appears to be more affected by silicon than phosphorus, and this accounts for the fact that, in the past, phosphorus as a chill-reducing agent has generally been ignored. Mackenzie[2] pointed this out when the modified Sipp diagram was first discussed in the United States. Nevertheless, the micro-chill that tends to be produced in phosphoric irons over a wider range of composition than visible chill, is likely to assume increasing importance where high-speed machining is carried out, since the presence of any free carbide is known materially to reduce the machinability, even though the iron appears to be grey in fracture.[10]

General Divisions

Either of the two diagrams is capable of providing useful information, but the second one is probably the simpler to use and will provide an adequate

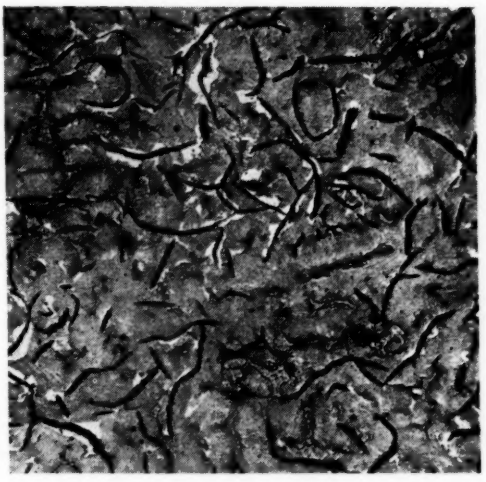

FIG. 8.—*Type I Structure—Ferrite, associated with Flake Graphite. Etched in* 4 *per cent. Picral.* ×100.

margin of safety against the production of unmachinable chill. The area of this diagram up to a bar diameter of 0.5 in. (plate thickness 0.25 in.) is of particular importance to the light-iron-castings industry, where ruling sections of $\frac{1}{4}$ to $\frac{5}{32}$ in. are common. It will be seen that chill is to be expected with C.E. of 4.3 to 4.4 in plate thickness of $\frac{1}{8}$ in. and with C.E. of 4.0 in plate thickness of $\frac{1}{4}$ in. In view of the fact that so many of this type of casting are flat and with extensive free edges it is customary to work with C.E. values of 4.5 to 4.7 to ensure an

FIG. 9.—*Type II Structure—Ferrite associated with Undercooled Graphite. Etched in* 4 *per cent. Picral.* ×100.

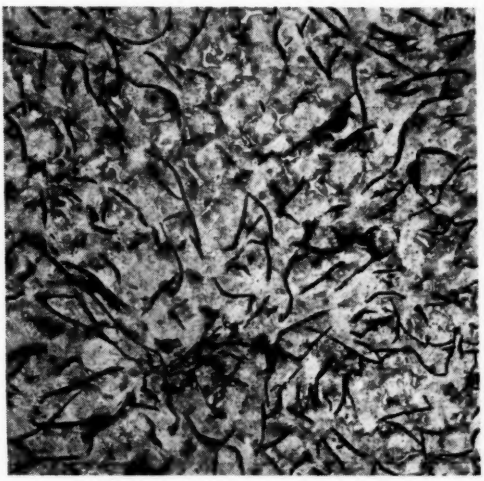

FIG. 10.—*Type III Structure—Completely Pearlitic Matrix. Etched in* 4 *per cent. Picral.* ×100.

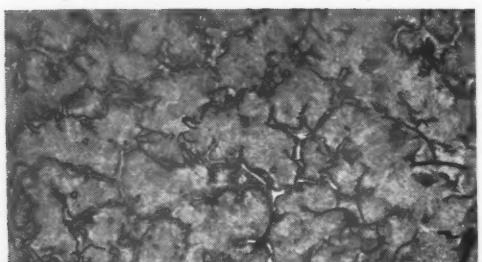

FIG. 11.—*Type IV Structures—Showing the Presence of Free Cementite. Etched with 4 per cent. Picral.* ×100.

adequate margin of safety against chill. It is extremely difficult to get a type III, all-pearlitic structure in sections below $\frac{3}{32}$ in. even with inoculation, as the type II undercooled graphite/ferrite/pearlite structure always tends to predominate. There is some indication that a high C.E. of about 4.7 will assist in suppressing the undercooled structure in thin sections, particularly if it is obtained with high carbon rather than high silicon, but this is not usually practicable. Where complete freedom from undercooled graphite-ferrite is desired in sections of the order of $\frac{1}{4}$ in., heavy additions of a graphitizing inoculant are usually required.

FIG. 12—*Type V—White-iron Structure. Etched in 4 per cent. Picral.* ×100.

In the area covered by 0.5 to 1.0 in. dia. bars (0.25 to 0.5 in. section), a fairly clear-cut zone can be drawn for pearlitic irons. This area is of particular interest to the light engineering and automobile castings industry. The emphasis here is usually on strength, freedom from ferrite for "lubricated" wear-resistance, and freedom from hard spots for conferring machinability. Here, the range of compositions available is fairly wide. It is fairly simple to avoid ferrite (type I) by keeping the C.E. below 4.3 to 4.2, and to avoid hard spots by keeping the C.E. above 3.8. This is consistent with normal automobile practice where the C.E. usually falls within 3.9 to 4.2. It will be seen that a C.E. of 3.55 marks the limit for 1.0 in. bars or 0.5 in. section, but this figure is only safely applicable to the centres of bars or plates or this section, the extreme edges being subject to a much more rapid cooling rate than the centres. End and edge effects are becoming less critical in the zone 1.0 to 1.5 in. bar (0.5 to 0.75 in. plate) as the pearlite limits are approaching the vertical, particularly on the ferrite line. A C.E. of 3.6 can be safely employed where free edges are beaded up to about 0.8 to 0.9 in. dia., but for free edges of 0.75 in. thickness the safe limit is 3.7 to 3.8.

Interpretation of Diagrams

The chief difficulty in using these diagrams is that of interpreting the results in terms of foundry practice, since it is quite impossible to make any allowance for section size except on the basis of standard sections such as round bars or flat plates, and it is necessary to interpret the results likely to be obtained in actual castings in terms of standard conditions. Schneidewind and McElwee[4] use the

term " equivalent diameter " to express the cooling rate of a given casting section, and this is a convenient method of expressing cooling rates for castings.

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(*To be continued*)

House Organs

Bulletin of the British Cast Iron Research Association. Vol. II, No. 7. Published by the Association from Alvechurch, Birmingham.

This issue, in addition to containing the usual features, carries a select bibliography covering articles since September, 1951, on the shell-moulding process, together with a list of germane patents.

Staveley News. Summer. Published by the Staveley Iron & Chemical Company, Limited, Hollingwood, near Chesterfield.

By and large this magazine is devoted to the social happenings at the works but there are included one or two articles of general interest but which carry a message for the industrial employee. It is well edited and profusely illustrated. The outside cover—a picture of a canal bridge—is particularly charming.

USCO Magazine. Vol. 3, No. 6. Published by the Union Steel Corporation of South Africa, Limited.

This issue carries an illustrated description of the new central chemical laboratories. They are provided with a pneumatic despatch tube which permits the receipt of a sample over a distance of 300 yards in 24 seconds. The existence of a new physical laboratory is also announced. For the rest it carries the usual features—social and sporting events, and a few stories.

Perkins News, Vol. 8, No. 4. Issued by F. Perkins, Limited, Peterborough.

This magazine has for the second year running been awarded the challenge cup and certificate for the best house journal submitted for competition in the B.D.M.A.A. contest. The reviewer confesses to ignorance for what these letters stand, but he commends the award, for the journal ranks high amongst works publications. The colour printing is of a high standard.

London Metal Exchange to Reopen

It was announced in Parliament that the Government had decided to reopen the London Metal Exchange for dealings in lead and that it was hoped that the dealings would be commenced on October 1. The Ministry of Materials has now announced that agreement had been reached with the committee of the London Metal Exchange on October 1 as a firm date for this purpose.

Trading on the London Metal Exchange in copper, tin, lead, and zinc was brought to a standstill by the outbreak of war in 1939, and it was no fewer than 10 years later—on November 15, 1949, to be exact—that the first move came towards a restoration of pre-war conditions on the exchange. That was the date on which dealings in tin were resumed. Even then, however, conditions were not such that the market had the full freedom for trading that it enjoyed before the war, when it was possible to transact business with buyers and sellers in all parts of the world without any monetary or other formalities in the settlement of accounts.

Zinc, it is expected, will be the next metal in which there will be a resumption of trading on the London Metal Exchange. The supply position in zinc is now quite normal and United Kingdom stocks of the metal are adequate. The Minister of Supply has also announced that the administrative arrangements which restricted the use of zinc for galvanizing iron and steel sheet, wire, wire products, and tubes were to be removed. Licences would still be necessary to acquire virgin zinc, but the allocation system would be discontinued.

The present London Metal Exchange building in Whittington Avenue was opened as a terminal market in 1882. The actual London Metal Exchange Company, Limited, was established in Lombard Court in the City of London in 1877, but it was long before then that a small group of merchants and merchant bankers who carried on the business of shipping, financing, and distributing metals, gathered informally in the Royal Exchange. Later they met at the Jerusalem Coffee House in Cowper Court and later still at the Lombard Exchange and News Room in Lombard Street. The Metal Market & Exchange Company, Limited, was incorporated on July 30, 1881. At the time of the outbreak of hostilities in 1939 the London Metal Exchange had become the world's market place for copper, tin, lead, and zinc.

More Steel for Shipbuilding

The increase in steel allocation to the shipbuilding industry for the fourth quarter of the year would now be 8 per cent. on the third quarter, Mr. S. W. Digby, Civil Lord of the Admiralty, announced in Newcastle-upon-Tyne last week. Mr. Digby, who had just completed a two-day tour of shipbuilding and shiprepairing establishments and marine engineering works on the Tyne and Wear, recalled that in July the First Lord of the Admiralty had told the House of Commons that the industry as a whole would be allocated an increase in supplies of not less than 5 per cent.

Commenting on the further increase, Mr. Digby said: " I realise only too well that this is insufficient to meet the full requirements of the industry, but these can only be met by an increase in steel production."

If the allocation for the fourth quarter continued at that rate, he said, it would enable the shipbuilding industry to produce new merchant shipping at a slightly higher rate than the maximum achieved since the war, which was 1,380,000 tons a year.

Permanent Midlands Exhibition

Consultations are now in progress between the Birmingham Metal Exchange and the National Union of Manufacturers on the proposal to establish permanent industrial exhibitions in Birmingham. Both the Metal Exchange and the N.U.M. have been in touch with the organizers of the permanent engineering exhibition which functions so usefully in Glasgow, and it is suggested that Birmingham and Midland manufacturers would welcome the facility to display their products under one roof for the convenience of buyers and agents who, at present, have to travel from factory to factory. The Birmingham Metal Exchange plans to reorganize its premises in Stephenson Place to house about 300 stands from light and medium engineering industries, while the existing amenities for members of the Exchange would be retained. It is anticipated that the interior of the building will have to undergo considerable reconstruction and that an extra storey must be added. Implementation of the scheme would depend on whether the necessary building licences can be obtained, but it is stated that work would start immediately on reconstruction if the licences were granted.

Mention has already been made in these columns of the N.U.M. proposal to lease and restore war-damaged buildings in John Bright Street, Birmingham, adapting them for exhibition purposes. Since that original idea was mooted, the N.U.M. has approached Birmingham Corporation asking for terms for a 10-year lease of the premises, but has received the reply that for so long a lease, more permanent work would have to be undertaken on the premises, with consequently higher costs. Meanwhile all members of the N.U.M. in the Midlands have been asked for their views and the matter is to be discussed by the exhibition committee which will report to the Midlands council of the union. Co-operation and discussion with the Metal Exchange is to ascertain whether the two projects could be linked, since each has the essential purpose of providing exhibition facilities. Both organizations are against having two separate exhibitions. Mutual arrangements, it is hoped, will result in a solution satisfactory to both bodies and to manufacturers in the area, and it is intended that all the industries in the Midlands shall be covered by whatever scheme is finally evolved.

Leeds Metallurgical Society

The Leeds Metallurgical Society is to hold a week-end conference on "Problems Arising from Metal Scarcities and the Use of Alternative Materials" at the Becketts Park Training College, Headingley, Leeds, 6. The introductory lecture will be given by Mr. D. A. Oliver, metal economy adviser to the Ministry of Supply, and director of research of the B.S.A. Group of companies. The session on "Protective Coatings and the Use of Alternative Materials" will be opened by Mr. A. W. Wallbank, managing director, Ionic Plating Company, Limited; "Problems of Heat-treatment of Substitute En Steels" will be introduced by Mr. R. Wilcock, chief metallurgist, Samuel Fox & Company, Stocksbridge, and "Substitution of Plastics for Metals" will be introduced by Mr. J. M. J. Estevez, of the development department, I.C.I. Plastics Division, whilst speakers of a similar standing will introduce other sessions on scrap reclamation and its contribution to metal supplies and the like. Additional details may be had from the secretary of the Society at 77, Alwoodley Lane, Alwoodley, Leeds.

Glasgow Firm's Productivity

The Glasgow firm of British Polar Engines, Limited, has doubled production in the past five years, with little increase in the labour force, as a result of reorganization and the installation of new machinery. This was revealed in a follow-up document prepared by the Anglo-British Council on Productivity on the achievement of the internal combustion engine industry since a productivity team from it visited U.S.A. in 1949.

Pointing out that the post-war period has seen great changes in the industry, the report states that it was difficult to disentangle the influence of the team's visit from that of general reorganization and expansion. Regarding the Glasgow firm, it is said that machining time has been markedly cut down by the introduction of new machines. For example, the time for machining connecting rods has been reduced by 70 per cent. Over the past ten years this company has carried out an extensive programme of reorganization, introducing new methods and techniques. Recently a small section was set up to concentrate on handling problems. The American method of induction hardening has been developed.

The American visit and the report published by the productivity team has led to a new freshness in approach to old problems throughout the U.K. industry, states the follow-up document. British direct exports of internal combustion engines have increased in value from £3,400,000 in 1938 to £25,000,000 last year, and when engine parts are included that figure rose to £33,000,000. The productivity team's report came in the middle of post-war rationalization in the industry, which still continued. The construction of a forging plant for the industry was decided against, although some imports of drop forgings would be required from the Continent for some time to come.

Coltness Foundries to be Discontinued

In a circular to shareholders regarding the future of the new company, Coltness Iron Company, Limited, which was formed, with a capital of £525,002 in ordinary shares, to take over and operate the activities not involved in the nationalization of the collieries, the joint liquidators state that the directors of the new company have informed them that, although the trading results, as a whole, have been satisfactory, it has been evident for some time that certain departments—particularly the foundries—no longer have a solid economic basis, and have been showing steadily diminishing returns. Immediately following nationalization of the collieries, the heavy outside demand for certain types of castings made it possible for the foundries to be continued for a few years on a narrow margin of profit. In recent months, however, the flow of orders on which the foundries rely has diminished materially, while costs have been steadily rising. The directors are satisfied that within a few months these departments will be uneconomic. They have, therefore, decided to close the foundries and certain minor activities, and dispose of the buildings and plant. It is estimated that the assets involved will realize rather more than the book values. The company will then be in a position to concentrate on its well-established and growing interests in the cement and brick trades. The liquidators intend shortly to take steps to make a distribution of two shares of 6s. 8d. each, fully paid, in the Coltness Iron Company, Limited, for every one held in Coltness Holdings, Limited. A further intimation will be made in due course regarding this distribution. The first accounts of the new company will be prepared for the period to September 30, 1952.

Methods Employed in the Production of Heavy Iron Castings*

Discussion of the Paper by Mr. J. Richardson and Mr. C. F. Lawson

MR. R. D. LAWRIE, opening the discussion, recommended members to study the first two paragraphs very carefully; there was a wealth of sense there which all could read, digest and practise.

MR. HAROLD HAYNES said it was the type of Paper founders needed, as it stressed craftsmanship. There was only one thing he would disagree with the speakers on, and that was chill. He was casting at the present time some camshafts, 4 ft. long. There were six journals, and on the thinnest part he wanted it to be chilled right through where the cam came. Therefore, he maintained founders should keep to the word "chill" because it was the word to use for that method of casting, and not for the process of absorbing heat.

Nomenclature

MR. LAWSON agreed with Mr. Haynes on the case mentioned. At the end of the Paper there was an illustration of a chilled-roll casting which had definitely been chilled in the accepted sense of the word, but in the Paper the Authors had felt they were not dealing with the same principle. He thought it was a question "For what reason were metal inserts being used; were they being used to create chill or to equalize rates of cooling." There were also other materials which could be used for either purpose, *i.e.*, to absorb heat at a greater rate than the normal mould materials. If a metal insert were used to absorb heat to equalize or balance cooling rates, then the principles and calculations would be different from those in which a definite chill was required, but there was a relationship between the two requirements.

When using metal inserts for densening purposes there was probably a certain amount of chilling on the face of the casting; this was another case of incompatible principles. In one case they wanted to equalize cooling rates, and in the other to effect a change in the physical structure of the metal.

THE CHAIRMAN (Mr. E. Longden) said he thought the real definition was the heat conductivity of materials. In the one case there was an equalizer of the heat-content, but one retained machinability; while in the other case, as he understood it, it meant the production of white iron.

MR. REYNOLDS said in his practice if he instructed: "This is to be cast with a chill," or if he instructed his men to use a densener, they knew exactly what was wanted, and he suggested that the average foundryman knew the difference between the two.

Stress-relieving

MR. F. GREAVES said he thought it unfortunate that on page 15 of the Preprint, when dealing with the wheel-centre, it should be stated that the last one of 20 was a failure. He did not ask how many they cast to get the replacement, but he was a little concerned to see that it was just accepted as a part of the job. Were not the others likely to crack in service? It sometimes happened that if the first or the last one of a batch cracked, the customer would return them all. Had any of the castings been stress-relieved?

MR. LAWSON replied he was sorry they had not mentioned stress-relieving, but it was rather a big subject. In that particular instance the casting cracked after it had been delivered over a fortnight; it was not cracked in the mould. It happened that the customer was quite aware of the problems in producing that particular type of wheel, in so far as with many similar types of wheel-centre arrangements were made to relieve stresses by splitting the boss, etc. They were fully aware of those facts, and they carried out the necessary stress-relieving themselves. Whether these castings could be made without stress-relieving was still a matter of some doubt.

MR. REYNOLDS asked if the type of metal used nowadays for castings at Brightside had been changed since a previous paper was presented.

MR. LAWSON thought the answer to that question was "No." The castings were made from unalloyed cast iron only. Apart from controlling the chemical and physical structure within the scope of unalloyed cast irons, these had not changed considerably within the last twenty years.

Hammer Blocks

MR. SPENCELEY said he would like the Authors to confirm, in view of the fact that one would expect densening and chilling of the hammer blocks mentioned, that this was not in fact done. What was the type of core material used for those particular blocks?

In reply, MR. LAWSON said for the hammer blocks the question of densening did not really arise. It was certainly a big section, but it could be regarded as uniform. There was no point in trying to control differences in temperature distribution within that sort of mould.

On the question of core materials, the requirements had been given and these could be met in quite a few different ways with different mixtures being used.

To give a particular composition: they used 40 per cent. of a proprietary material, 20 per

* Paper printed in the JOURNAL, August 14 and 21, 1952.

Methods Employed in the Production of Heavy Iron Castings—Discussion

cent. silica sand, 25 per cent. Worksop sand, 15 per cent. ganister, which had previously been calcined. There were other mixtures. The Worksop sand was included mainly to make the material mouldable.

Sands Used

MR. HUGHES. in connection with the type of sand used, wondered how desilting gave a wide spread of grain size. Surely, it tended to reduce the spread. The difference between the sand used in one foundry and that in the other was remarkable, particularly when it was realized that the type of castings were comparable. Could the Authors say why there was such a large difference in permeability between these sands, as it would appear that the one with the lower permeability was of a much coarser nature. If it was mainly the result of the silt content, it obviously indicated the important part that this constituent plays on the permeability of moulding sand.

It must be difficult to calculate heat transfer, even approximately, when chills were being used, particularly on a large casfing where it was difficult to assess the amount of metal flowing over the particular surface. Could the Authors give any indication of the life obtained from chills and had they experienced any trouble from gas generation when they had been in use for a considerable period of time.

The last speaker had referred to the production of hammer blocks and the care required to make a sufficiently suitable core to withstand the very high temperatures. Could the Authors say what type of material was used for reinforcement?

Referring to the press-slide casting, the Authors mentioned that they had so arranged the running of the job to ensure that metal was passed over the slides for pre-heating and to avoid flushing. How did one know that the metal was flowing over the slides? Surely, the high rate of heat exchange would immediately result in a skin of metal forming against the densener. What was intended to be conveyed by the expression "pre-heated during casting"? The Authors had realized that there was no golden rule for each particular casting, and in this way the services of an experienced foundryman could be of immeasurable value.

Grain-size Distribution

MR. LAWSON replied that when talking about grain-size distribution, they referred to the actual sand grains, and not silt or clay. In desilting they did not remove sand grains, but merely particles of dust and fines. There were many sources of dust in a foundry, such as burnt clay, coal-dust, blacking, whitening, coke dust, etc., which if removed from the sand allowed the permeability number to rise rapidly. This could be tested in reverse by adding about 2 per cent. fine material, *i.e.*, powdered clay, to a normal sand having a permeability number of 50 A.F.S.; the permeability would decrease. This could be seen in the two foundries mentioned. In one the grain-size was larger, but there was no desilting, and the permeability was much lower than in the other foundry having a sand of finer grain, but practising desilting.

Referring to heat-transfer calculations, the Authors had said "roughly calculated," and by this implied the difference between theoretical mathematical calculation and judgment backed up by knowledge of heat-transfer principles. Experience was necessary, and with it they modified their calculations.

On the question referring to the hydraulic-press head, the slide denseners were in the vertical plane, and it was not a question of metal flowing over them, but one of the metal rising up as the mould filled.

With regard to reinforcement of the cores in the hammer blocks This was a matter of using wrought-iron bar of a suitable diameter; an important aspect was that the diameter of the bar had to be in relation to the bending moment across it. Though it might sound silly to say that a 1-in. dia. round bar would resist bending more than a $\frac{1}{4}$-in. dia. bar at elevated temperatures, he had seen similar castings made in which the coremaker had put in iron of small diameter, and the core finally bent or broke by flotation.

Referring to tangential and drop gates, Mr. Hughes had said that in both cases the purpose was the same—to produce sound castings—implying that it did not matter much which were used. The Authors insisted that it did matter: the whole object of everything that they did in the foundry was to produce sound castings, but it was necessary to get down to fine detail control.

Vote of Thanks

THE CHAIRMAN (Mr. E. Longden), proposing a vote of thanks to the Authors, said there were two points he would like to make. Gear centres had been manufactured up to 21 tons and in the larger sizes it was definitely insisted on that the centre boss should be split by cores, but, in spite of that, the precaution of taking the core out and cooling the boss with a draught of air from the compressed line was always very necessary. With the smaller sizes it was sufficient without splitting the boss to adopt the air-cooling method.

Having had some experience of steelfoundry work, he would recommend cast-iron founders, where they were dealing with heavy castings subject to high pressure and high temperature, to use zirconium sand for small cores mostly surrounded by metal. It was a sand which was very expensive, probably eight times the price of ordinary sand, and a sand with a much higher density than ordinary sand, but they would be agreeably pleased with results if it was adopted.

G. W. SMITH & SONS, INC., of 5400, Kemp Road, Dayton 3, Ohio, U.S.A., announce the availability in the United Kingdom of Plunger-slick, a lubricant for the piston (ram or plunger) on cold-chamber die-casting machines. It is to be distributed by W. J. Hooker, Limited, 4, Midland Crescent, Finchley Road, London, N.W.3.

Pig-iron and Steel Output

Steel and pig-iron production figures for July, released by the British Iron and Steel Federation, are encouraging. Output of steel was affected by holidays, but it shows a marked increase compared with a year ago, reaching an annual rate of 14,236,000 tons, against a rate of 13,317,000 tons in July, 1951. The improvement in pig-iron production continues, output in July being at an annual rate of 10,482,000 tons, compared with a rate of 9,484,000 tons in July of last year.

In considering the increase in steel output over that of the previous July, it must be borne in mind that annual holidays at some of the works, normally taken in July, are this year being taken in August. A further factor is that July this year was a slightly longer working month than July, 1951. New blast-furnace capacity enabled pig-iron output to be stepped up appreciably last month.

So far this year, the average annual rate of steel production is 15,809,000 tons, which is only 100,000 tons below the average over the same period a year ago. The weekly average output has increased steadily during the past three months.

Latest steel and pig-iron output figures (in tons) compare as follow with earlier returns:—

	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1952—May ..	201,100	10,456,000	312,400	16,245,000
June ..	199,700	10,384,000	312,500	16,252,000
1st half year	199,900	10,397,000	308,600	16,046,000
July.. ..	201,600	10,482,000	273,800	14,236,000
1951—May ..	182,400	9,482,000	305,100	15,864,000
June ..	182,600	9,497,000	307,800	16,007,000
1st half year	182,800	9,506,000	313,600	16,306,000
July.. ..	182,400	9,484,000	256,100	13,317,000

Rise in Australian Steel Output

Steel output in Australia is showing a marked increase. During July the Newcastle works of the Broken Hill Proprietary Company produced 60,000 tons of pig-iron, against 58,000 tons in June, 74,000 tons of ingot steel, against 73,000 tons, 71,000 tons of blooms and billets, against 66,000 tons, 57,000 tons of sections, against 49,000 tons, and 38,000 tons of merchant bar, against 30,000 tons. Increased output was due mainly to better supplies of coal and labour.

Output at the Port Kembla works of Australian Iron & Steel also rose over the previous month's figures, reflecting the settlement of a strike.

Higher U.S. Steel Prices

The United States Government ended the wage/price dispute in the American steel industry last week by agreeing to higher maximum prices for a wide range of steel products. The Office of Price Stabilization issued an order granting an average of $5.65 a ton increase for steel in accordance with the instructions on July 24 of Mr. John R. Steelman, acting director of mobilization, to grant the increases as one step in settlement of the long steel strike.

Mr. Steelman had acted over the head of Mr. Ellis Arnall, the price stabilizer, who had insisted that the increase should not be more than $2.84 a ton permitted under the existing price standards.

Foreign Competition

German and Japanese competition in the overseas markets has recently been discussed at length by the Midland Council and by Area Committees of the National Union of Manufacturers, and, as a result, a proposal is being considered to send British workers to Germany to study working conditions there. Investigations made by the Area Committees elicited much pertinent information. Wolverhampton Area Committee was told that East African markets are being captured by the Japanese with lower-priced goods, and members complained that the present system of taxation tends to make employees become machine minders instead of craftsmen. This committee supported a proposal to send a group of men from shop-floor level to see German workers' conditions.

At Dudley the Area Committee was informed by members, that ball-bearings from Switzerland, Italy and Japan, all cheaper than British-made bearings, are flooding into overseas markets, and it was reported that some manufacturers in this area had received cancellations of orders from overseas' buyers, who now know that they can purchase more cheaply elsewhere. Stoke-on-Trent Area Committee passed a resolution that "It will soon be impossible to sell British goods in certain overseas markets owing to continued increases in the cost of manufacture," and urged that the Government be called upon to cut taxation so that British manufacturers may compete on equal terms with foreign. Walsall Area Committee similarly received evidence of the sale in overseas markets of Japanese goods at a fraction of the cost of the British product.

Mr. E. Holden, Midland Area secretary of the N.U.M., states that reports from member firms throughout the Midlands tell the same story and leave no doubt that German, Japanese, and latterly, Austrian manufacturers are intensifying their efforts to compete successfully in a wide range of products.

Dangers of Officialdom

Bureaucratic control in the steel industry was denounced as an evil by Mr. W. H. Higginbotham, chairman of Edgar Allen & Company, Limited, Sheffield, at the company's annual meeting. The proposals for denationalizing the industry, Mr. Higginbotham said, envisaged a scheme of control—of policy, capital investment and expansion, production and prices, and materials supply—which extended far beyond anything previously existing or contemplated. In principle, he declared, the imposition of control without acceptance of financial responsibility for the consequences of its policy and actions was bad. In so far as the proposals represented a political bargain to ensure that no future attempts at nationalization were made, there was no possible guarantee that this would be effective. It was essential, he continued, that whatever replaced nationalization should free, rather than restrict, those who had to manage it and give them the fullest possible scope for the exercise of their skill and ability. This could never be under a system of licences, permits, directives, centralized decisions and delays.

Let it be remembered, warned Mr. Higginbotham, that all these systems of control, once imposed, were hard to remove. Officialdom sought always to maintain and extend its authority and activities, and never lacked argument to support its claims.

MR. M. I. FREEMAN has been appointed a director of the National Smelting Company, Limited.

Personal

MR. K. SAARIKOSKI has been appointed foundry manager to Bolinders Fabriks A.B., Kallhäll, Sweden.

BRIGADIER THE HON. HUGH K. M. KINDERSLEY has been appointed deputy chairman of Rolls-Royce, Limited.

MR. F. MARSHALL, B.Met., has joined the metallurgical staff of the Research and Development Division of the British Steel Founders' Association.

MR. R. A. ARCHIBALD has been appointed managing director of the Planet Foundry Company, Limited, ironfounders, etc., of Guide Bridge, near Manchester.

MR. LIONEL BARBER, a director of Sheffield Twist Drill & Steel Company, Limited, has been appointed secretary in place of the late Mr. C. C. Claxton.

MR. WALTER J. JONES has been appointed secretary of James Austin & Sons, Limited, iron and steel stockholders and engineers, etc., of Dewsbury (Yorks).

MR. HERBERT LESLIE WYNEKER, secretary accountant of Edgar Allen & Company, Limited, Sheffield, has resigned to take up an appointment with L. J. Harris & Company, Limited, of Stoke Prior. He is succeeded by Mr. Francis Alan Ross.

TWO ASSISTANT WORKS MANAGERS of Peglers, Limited, brassfounders, Belmont Works, Doncaster, MR. F. BARK, and MR. H. BROWN, have been appointed directors of the company. Both men have been with the company for many years.

MR. R. G. TURNBULL has relinquished his appointment as assistant engineer manager of Harland & Wolff, Limited, Belfast, and has joined C. H. Bailey, Limited, ship repairers, of Barry (Glam), as engineer manager, under MR. W. W. DAVIES, the manager.

MR. THOMAS TREVOR JONES has retired at the age of 65 years, after 50 years' service with John Smith & Company (Derby), Limited, non-ferrous founders and engineers, Cotton Lane, Derby. Mr. O. J. Jackson, chairman of the directors, presented Mr. Jones with a cheque.

AFTER 35 years as a Justice of the Peace, MR. A. W. LESTER has retired at the age of 75. He will still serve on the supplemental list. Mr. Lester, who is chairman of the Walsall District Iron Company, Limited, was for 11 years a member of Walsall Town Council.

JARROW METAL INDUSTRIES, LIMITED, of Western Road, Jarrow, announce that the following appointments have been made:—Mr. E. B. Ellis, as manager; Mr. J. Hetherington, as works manager; Mr. C. A. Morrison, as foundry manager, and Mr. E. Fairlamb, as melting-shop manager.

MR. V. R. LEDWIDGE, a son-in-law of the late Mr. W. F. Shearing, has been appointed managing director of London Metal Warehouses, Limited. Mr. Ledwidge joined the Company in 1945 immediately after his demobilization from war service in the Far East, and was appointed to the Board in 1946. MR. A. G. DOCK, for many years the foundry manager, has been appointed a director of the Company.

SIR WILLIAM LITHGOW, 18-year-old- baronet, is to become a Clydeside shipyard apprentice. In this way he will learn shipbuilding right from the bottom, as his father and grandfather did before him. He left school at Winchester last month and is heir to his father's £1,059,180 estate, of which death duties amount to £808,978. He plans to begin his apprenticeship in the autumn.

Iron and Steel Corporation's Report

The first annual report of the Iron and Steel Corporation of Great Britain has been published and the following points of interest to founders have been abstracted. The Corporation was appointed on October 2, 1950, and on February 15, 1951, became responsible for 298 companies employing nearly 300,000 people, with an annual turnover of more than £500,000,000. The report, which covers the first financial period to September 30, 1951, therefore relates to only seven-and-a-half months' trading, and the consolidated profit, after depreciation, amounts to £34,496,452. The total of depreciation set aside by the companies was £8,405,253, and the Corporation increased this by £5,000,000 in order to provide for additional costs and replacement of fixed assets at current prices. Interest on British Iron and Steel Stock and other charges in connection with this stock, together with interest on loan and debentures, absorbed £6,903,573, leaving profits before taxation of £27,592,879. Taxation took £19,631,506 and, after allowing for the interests of outside shareholders, £169,797, there remained profits retained in the group of £7,791,576. The companies' profits have been enhanced by the high export prices obtainable in some markets for iron and steel products and in addition substantial profits have come from other activities such as general engineering and structural engineering. The same level of profitability is not expected when more normal trading conditions return.

Scrap and Coke

Shortage of scrap is given in the Report as the most important single factor reducing steel output in 1951; imports from Germany were 1,490,000 tons less than in 1950. Consequently the scrap ratio, *i.e.*, scrap used as part of steel output, fell from 63 per cent. in 1950 to 50 per cent. in 1951.

Except for the efforts made in the industry itself, the national scrap drive fell short of expectations in 1951. Home-bought scrap was expected to increase by 250,000 tons, but, in fact, home-bought deliveries fell short of 1950 by 104,000 tons. In the iron and steel industry, however, own arisings yielded an extra 325,000 tons from obsolete plant, buildings, and general clearing up.

The industry produces about 70 per cent. of its coke requirements. Although there were some local shortages early in 1951, the total coke receipts at blast furnaces increased by 454,000 tons over 1950. The Corporation has taken steps to ensure that furnace and coke-oven development are related. By the end of 1952 the blast furnaces are expected to require 240,000 tons weekly.

Labour and Earnings

Of the 292,000 persons employed by publicly-owned industry at the end of September, 1951, some 225,000 were engaged in iron- and steel-making activities. The majority of the others were in constructional and general engineering and about 10,000 were in iron foundries.

Average weekly hours worked at the end of September, 1951, were:—Process workers, 46.7; general and maintenance workers, 49.7; technical, administrative, and clerical workers, 40.5. Average weekly earnings for the week ended October 6, 1951, were:—General and maintenance workers, £8 16s. 7d.; administrative, technical, and clerical workers, £8 8s. 2d. Process workers ranged from £8 9s. 5d. for those in tinplate manufacture to £10 5s. 7d. for workers on steel-melting furnaces.

Flow of Metal*

Buxton Conference Discussion of the Report of Sub-committee T.S.35

THE PRESIDENT, Dr. Dadswell, calling on Mr. E. M. Currie to present the report and film of sub-committee T.S.35 on the Flow of Metal, said, as they knew, Mr. Currie was the chairman of the sub-committee. The sub-committee had done a very comprehensive and fine piece of work which he thought would go on record once again as a work which would add to the prestige of the Institute. Mr. Currie then explained the reasons for the general purpose of the film, its relation to correct gating practices and its use in any discussions on that subject. Several slides illustrating particular points were then shown, after which the colour film, showing in slow motion the various flow patterns of the metal flowing through many different types of ingates, was projected. This film was made by Foundry Film Services Limited.

Commenting on the film and opening the report for discussion THE PRESIDENT said they would all have been impressed by the film and by its presentation. As Mr. Currie had said, it was a novel form of making a report to the Institute and it now occurred to him (the President) that it had something in common with the making of all reports. In carrying out technical investigations they did not see and did not realise readily how much exploratory work was then done and discarded before one received the final picture of the particular subject being investigated. He was quite sure, having tried a little amateur cinematography, there must have been a great deal of exploratory work to develop the technique, and courage afterwards to know what to cut out, before giving the proper and final story.

Velocity Head

MR. A. E. PEACE said, not knowing what Mr. Currie was going to say in introducing the film, he had been very pleased with the excellent way in which he had made the introduction. It was necessary to have considerable explanation beforehand because the film developed the subject so quickly.

He had felt that in all the pictures they had seen they had amplified the effect of the velocity head and it seemed that it was of paramount importance, in understanding what was going to happen, to appreciate this point with various ingates and the position of them in relation to the runner bar. He did not know whether Mr. Currie might enlarge more particularly on the spoked wheel series. He had found this series particularly illuminating in showing very clearly the way in which some of the metal flowed back from the boss which he thought founders would not suppose would happen unless they had actually seen it and given close study to the velocity-head effect on the direction of metal flow.

MR. CURRIE in reply said there was no doubt that to a certain extent the direction and pattern of the flow of the metal in the mould was bound to be slightly different in appearance if they made the basin some four or five inches higher. The thing that had fascinated him was the opportunity it afforded of using actual metal in many types of open mould, to see clearly the way metal flowed, and to have a record to study repeatedly. At one time a firm were making large turret castings. In order to get satisfactory soundness they were casting them with a head of metal about 3 ft. high and obviously any gas which came off from the mould surface had no chance to go through the metal and was forced back through the mould vents. A different effect would certainly have been produced had they altered the velocity head of the metal, but of course his audience would realise that it would have been utterly impossible for them to have photographed those moulds as was done in this film. He agreed, as he had said at the outset, that there were inevitably some limitations in trying to do that, but the sub-committee had felt that if they started off to record simple elementary forms of ingates then from that there might arise a section into which they could go further. That was what happened with regard to the spoked wheel. They felt there that having got over patterns of simple open shapes they would like to see what happened when they took a gear wheel or a pulley with arms.

Pouring Methods

Obviously, of course, there was at least another half dozen ways of running the same casting. A number of foundrymen would probably put a couple of direct down-gates on to the centre boss and run it that way but it would be obvious that method was outside the scope of motion photography. The pattern of behaviour in which the metal flowed straight over from the ingate into an arm and the boss would always occur where they had an ingate directly opposite an arm and sufficient velocity of metal to leap over the mould cavity of the outside rim. In such a case some stress and strains must be created in the casting on cooling. Generally speaking, he found that where they ran pulleys and gears in that manner, the spokes were, especially towards the outside rim, liable to crack on removing the casting from the mould, or perhaps some crack would be found in the fettling shop next day. Therefore he would like members to look at the method of filling a mould from the angle of getting an even rate of cooling of the metal in the mould; to avoid causing stresses and strains, and to get good clean castings.

A MEMBER paid tribute to the work which had

* Report printed in the JOURNAL June 26, 1952.

been done by the sub-committee but he would like to know, since Mr. Currie had said a good many people having to pour the gear wheel would have put in two runners to the centre, what was the purpose of the experiments since no one would pour them in the way the sub-committee had poured them?

MR. CURRIE said if he had given the impression that the majority of people would pour that way it was not quite correct because there were many more ways of running the same pattern. A number of people would run it on the centre boss, obviously. They could put one, two, or three downgates on the centre boss, or the outside rim or even get an ingate between two arms. He would answer the question in this way:—A simple gear pattern had been chosen that could possibly be responsive to running on the boss. Suppose it was a gear pattern with a heavier rim, or a flywheel, it might be asked if it was desirable to run it on the outside towards the centre boss rather than in the reverse direction if they wanted an absolutely clean and solid outside rim. One might find that the better plan, because of a much greater thickness of the outside rim, it might be necessary to run it on the centre boss with a riser on it and run straight into the riser thence into the casting, and thus equalize cooling rates.

Founders could of course do what they liked with such types of castings, and it seemed to him that it was largely a matter of personal choice. But after nearly thirty years experience of foundries he had realised one fact—there were many ways of running a casting, but there was not one "best way."

Alternative Positions

MR. P. A. RUSSELL said that several films he had seen brought out the major fact that the stream of metal proceeding at speed in one direction would continue in the same direction. He thought founders should all appreciate when they thought about the film that the moulds were cast with the runner right down on the mould joint so that the velocity was very much reduced. The effects seen on the film, when used in an ordinary mould, would be multiplied about four times due to the fact that there was much more head pressure. Was it not possible to make an experiment where a mould was made with a top, including a normal runner; with part of the top cut away. It could be photographed from the side so that the effect of six inches of head metal instead of only about one inch could be observed?

MR. CURRIE said that the sub-committee had considered that. When they first began to examine their particular job they had thought of putting a type of heat-resistant glass in the side of the mould and seeing what happened with a higher head pressure. A rough experiment was carried out, but the glass clouded over so quickly that it was impossible to photograph. They fully realized there was the limitation of metal velocity to consider and that they would have to accept it. They felt that the difference in basin height on a normal 14 by 16 in. box would only be somewhere about five inches which would not make much difference to velocities comparisons. They could only answer at that stage that they had not proved this point, but had only thought about it. They might have an opportunity to try it out in the future.

Vote of Thanks

THE PRESIDENT, closing the discussion, said he was taking upon himself the proposing of a vote of thanks because he wanted the vote to be accorded not only to Mr. Currie for his presentation of the film and paper, but he thought they should couple with it the names of the members of the sub-committee:—Mr. Currie, Mr. Hudson, Mr. Nicholls, Mr. Ruddle, Mr. Hird and Mr. Lambert, the secretary of the sub-committee.

MR. HALLETT seconding the vote said he thought all had been fascinated by the film. Some of them had seen it before, but it represented some very fine work indeed and was an interesting parallel with some of the American work to which Mr. Lillieqvist had referred. In some ways it covered parallel work and in others it broke entirely new ground. He was sure the members of the Institute did thank Mr. Currie and his sub-committee for the magnificent work they had done.

MR. CURRIE, responding, said he had been backed by a good committee of practical foundrymen who knew what they wanted.

Krupp's Steelworks Compensation

If an Allied reorganization plan goes through, Herr Alfreid Krupp, heir to the Essen armaments combine, will receive about 360,000,000 marks (£30,000,000) in compensation for the steel and coal undertakings which the Allies are taking out of his control. In addition, his other properties, estimated to be worth 300,000,000 marks (£25,000,000), will be returned to him as soon as the Krupp concern is decontrolled.

Under Allied law, which split up and reorganized the Ruhr heavy industry concerns, Herr Krupp is not allowed to control coal or steel assets owing to his connection to the Nazi régime. He was released from Landsberg Prison last year after serving part of a 12-year sentence for employing slave labour.

New Patents

677,896 CHATFIELD, H. W., and MULLARD, S. R. Furnaces for the exfoliation of vermiculite.

677,904 UNITED STEEL COMPANIES, LIMITED, and REEVE, L. Separation of iron from its ores.

678,015 MAGNESIUM ELEKTRON, LIMITED. Magnesium base alloys.

678,178 KENNAMETAL, INC. Corrosion-resistant hard sintered compositions of matter.

678,027 HIGH DUTY ALLOYS, LIMITED, and DOYLE, W. M. Production of magnesium base alloys.

678,070 MEZGER, E. Device for lifting off the mould box portions from a moulding machine and for the covering of the mould box.

News in Brief

TWELVE PAKISTANI civil servants completed a week's stay in Birmingham on August 22, during which they visited many factories in the area.

A SURVEY of economic and commercial conditions in Egypt was published by Her Majesty's Stationery office on August 19, price 4s. 6d. (post free 4s. 10d.).

ANTIMONY ORE was nominally quoted in London on August 18 at 22s. 6d. to 27s. 6d. per unit c.i.f. for 60 per cent. material. Previously the range was 25s. to 27s. 6d.

FALL INGS FOUNDRY COMPANY, LIMITED, have had plans drawn up for the erection of a new staff canteen and office block at Fall Ings Foundry, Ings Road, Wakefield.

MR. W. MATTHEWS, training officer at the Stanton Ironworks Company, Limited, gave a 35-minute talk on "Training in Industry" to members of the Swadlincote Rotary Club.

G. H. LANGER & COMPANY, LIMITED, of Johannesburg, have developed and placed on the market a new type of sand-preparing machine to be known as the Langco portable Sanderator.

BRITISH RAILWAYS carried 145,595 tons of iron and steel during the week ended August 9, an increase of about 10,000 tons on the amount carried in the corresponding week of last year.

THE BRITISH BRONZE & BRASS INGOT MANUFACTURERS ASSOCIATION have arranged a general meeting at the Queens Hotel, Birmingham, on September 2, to be preceded by luncheon at 1 p.m.

THE UNITED STATES STEEL CORPORATION, New York, is planning to build nine ore carriers of 40,000 tons carrying capacity. The vessels will be used to carry ore from Venezuela to the United States.

AN ORDER has been received by William Doxford & Sons, Limited, Pallion, Sunderland, for a 14-knot cargo ship of 9,000 tons for Andrew Weir & Company, Limited. Delivery will be made in four years' time.

THIRTY-FIVE expert bellringers, members of the Universities' Association of Change Ringers, visited the bell foundry of J. Taylor & Company, Loughborough; afterwards they were entertained to tea by Mr. Paul Taylor, at his home.

AN ORDER for military electronic equipment valued at approximately $4,200,000 (£1,500,000) has been received by the British Thomson-Houston Company, Limited, Rugby, from the United States Army, European Headquarters Command.

THE GENERAL ELECTRIC COMPANY, LIMITED, has been entrusted by the National Coal Board with a contract for two 3,700-h.p. electric skip winders, together with the whole of the control and protective gear, which are to be installed at collieries in Yorkshire.

TREASURY PERMISSION has been received by Edgar Allen & Company, Limited, steel manufacturers, of Sheffield, for the issue of 430,945 £1 ordinary shares as capitalization of reserves. The new shares will double the existing issued ordinary capital.

WILKINS & DENTON, LIMITED, London and Rushden, are making show-case displays of "Totector" safety footwear, consisting of three pairs of boots and three pairs of shoes, all with internal steel toecaps, at 12 works of Richard Thomas & Baldwins, Limited.

THE THIRD ANNUAL SUMMER SCHOOL of the Institution of Production Engineers began at Ashorne Hill, Leamington, on Monday. Sir Cecil Weir, former chairman of the Dollar Export Board, delivered the opening address—his first to members of the Institution since he took office as president last month.

NOTICE OF DISMISSAL has been given to 110 employees at the Wheatley (Doncaster) works of Crompton Parkinson, Limited, manufacturing engineers. It is believed that this has been brought about by the decline in the export market and particularly by the limitation of imports imposed by Australia.

MR. DAVID BROWN, chairman and managing director of David Brown & Sons (Huddersfield), Limited, engineers and founders, Huddersfield, has authorized the gift of a tractor, worth £582 16s. to be auctioned at Exeter Market on Friday for the benefit of members of the farming community in the flooded areas at Lynmouth.

ADDITIONAL SPACE has been granted to the Remington Rand, Limited, at Hillington industrial estate, Glasgow, to allow them to proceed with the manufacture of the noiseless No. 10 typewriter, in addition to the present models being manufactured. The necessary additional machine tools, equipment, and an initial supply of components and material are being shipped from Hamilton, Ontario, and will be installed in the new extension at Hillington during the autumn.

LINCOLN & NOLAN, LIMITED, sole concessionaires for the assembly and distribution of Austin and Rover vehicles in Eire, have built and equipped a new factory at Merchants Road, Dublin, at a cost of £175,000. The firm has been assembling the vehicles in their old factory at Wapping Street, Dublin, since 1936, but the new premises will give an additional 38,000 sq. ft., space which it is anticipated will be needed when the manufacture of the Austin Seven is begun in the autumn.

WEDNESBURY narrowly beat Willenhall by three tons in the friendly scrap-metal collection contest which ended on August 23. Willenhall's own target of 50 tons was beaten by 35 tons; Wednesbury, which has a 4,000 greater population, collected 88 tons. In a last-minute effort, Willenhall salvaged an old concrete mixer, tar melter and road roller from the Council's yard. At a Willenhall club, a discarded slot-machine, not used for the past 14 years, was broken down for scrap (incidentally it was found to contain 12s. 6d.!).

FACTORY EXTENSIONS and new plant, costing more than £3,000,000, have been ordered by the Singer Sewing Machine Company, Clydebank, in their greatest development scheme since 1914. A new four-storey building, to be used as a needle factory, will be the largest and most up-to-date sewing-machine needle manufactory in the world. A start has also been made with new five-storey extensions to the main buildings. These are expected to be occupied in about two years. Altogether 239,000 sq. ft. is being added. In addition, the company is providing its own power plant.

AFTER A HEARING lasting over two hours, the jury at the inquest at Rugby on Mr. Thomas Frederick I'Anson (48), of Nelson Way, Rugby, who was killed in an accident in the foundry of the works of the E.E. Company, Limited, Rugby, returned a verdict of "Accidental death." Automatic control failure on a machine used for moulding was blamed for the accident. A metal and wood pattern-board, weighing about 1¼ tons, fell on Mr. I'Anson as he was working on some coreboxes and crushed him to death.

Raw Material Markets

Iron and Steel

Some foundries dealing with domestic castings are experiencing a slight falling-off in new business. Makers of textile machinery, for instance, are finding that new orders are now coming through less frequently. This recession has not yet affected output at the foundries, but it has meant that delivery dates for new textile plant have narrowed. Instead of having to wait many months, buyers are now being promised delivery within a much more reasonable period. No difficulty is, however, experienced in distributing all the foundry pig-iron which can be produced; there is still a strong demand in spite of licences being curtailed in many cases. The demand for hematite and low-phosphorus pig-iron is incessant, while the makers of high-phosphorus iron are still behind schedule with deliveries. No ordinary foundry iron is being sent abroad, but the Board of Trade will sanction limited quantities of refined pig-iron for oversea destinations.

Foundries are obtaining adequate quantities of ferro-alloys, while supplies of ganister, sand, and firebricks are comparatively easy. Coke is generally being received up to the allocated quantities, but foundries would like to secure extra supplies in order to create some stock for the winter period.

Supplies of Continental semis continue to arrive at a slightly better rate than in recent months, but the current supplies of raw material remain insufficient to keep the re-rollers' mills in full production. The sheet mills, too, have received some Continental sheet bars; the mills have sufficient orders on their books to last them to the end of the year in spite of a slight recession in the demand from abroad. The rollers of small sections, strip, and small bars have plenty of business on home accounts, and many of them are not taking up their full quantity of export orders because their current prices are several pounds above Continental levels.

Non-ferrous Metals

From time to time the view has been expressed that the action taken by the U.S. Government in holding the domestic price of copper down to 24½ cents was operating to discourage production. It was encouraging therefore to learn from the figures published by the American Copper Institute that the output of crude copper in July amounted to 82,138 short tons, nearly 2,000 tons up on the previous month. Refined copper production came to 96,049 tons, against 92,151 tons a month earlier, so that here, too, there was a useful gain. The jump in deliveries to domestic consumers was quite sensational, for the July tonnage at 115,179 tons compared with 98,416 tons in June. Stocks of refined copper also improved by about 3,000 tons to 73,657 tons. Outside the United States there was a fall in crude copper output of about 10,000 tons to 118,972 tons. There was also a marked drop in the production of refined copper from 114,421 tons in June to 99,201 tons in July. Stocks dropped by about 12,000 tons to 180,392 tons.

Other news of copper outside the United States is that the price of copper in Australia has increased by £A65 to £A350, which brings it approximately into line with the UK level of £285, equal to £A356. It should be noted that Australia is obliged to import approximately two-thirds of the copper consumed in the country.

Tin prices continued to rise up to yesterday (Wednesday). No further news has come to hand regarding the negotiations between the American R.F.C. and the Bolivian producers, but, nevertheless, it is believed that an agreement will be reached for Bolivian tin to enter the United States. The price is unlikely to exceed $1.21½ per lb. No changes are reported in the prices of the other metals, which seem to have settled down to a quiet and steady spell.

Official tin quotations were:—

Cash—Thursday, £961 to £962; Friday, £965 to £968; Monday, £968 to £969; Tuesday, £965 to £966; Wednesday, £963 to £964.

Three Months—Thursday, £939 to £941; Friday, £946 to £948; Monday, £946 to £947; Tuesday, £946 to £947; Wednesday, £945 to £946.

In this country interest centres mainly, as can be understood, on lead in which a free market will be re-established on October 1 next. Thirteen years is a long time for trading to be suspended and it is not surprising that the committee of the Metal Exchange is reported to be doing everything possible to ensure that this venture proves successful. In this the Government is equally interested, for having decided to give up bulk purchasing and price control it is obvious that, should things fail to work out satisfactorily, the administration is likely to come under censure. However, fortunately, there is no reason to suppose that any insuperable difficulties will arise, and, indeed, it is even being suggested that we shall see zinc freed before many months have gone by.

The Minister of Supply has made the Copper, Zinc, etc., Prices (No. 5) Order (S.I. 1952, No. 1548) reducing the prices of brass, brass scrap, and gilding metal scrap to take account of the recent alterations in the Ministry of Materials' selling price for virgin zinc. The prices of 60/40 brass and brass scrap are reduced by £4 per ton, all other grades of brass and brass scrap by £3 per ton, and gilding metal scrap by £1 per ton. The changes became effective on Monday.

Iron and Steel Price Changes

A new Iron and Steel Prices Order came into force on Monday. The prices of certain qualities of alloy steel and stainless steel products have been revised to take account, among other factors, of the changes in production caused by measures taken to conserve nickel and molybdenum; and also to take account of increases in the prices of alloy materials. The Order also removes blast-furnace ferro-manganese from statutory control. The price will in future be fixed by agreement between the makers and the Minister of Supply.

Rainwater and soil goods, gutters, and connections are removed from Iron and Steel Price Control. The Minister of Works will be responsible in future for pricing questions for these products. A number of other minor changes, including decreases in the prices of some galvanized articles to take account of the reduction of the price of zinc, are also made.

The changes are being made in agreement with the Iron and Steel Corporation of Great Britain. The new Order is the Iron and Steel Prices (No. 2) Order, 1952 (SI No. 1554).

Latest Foundry Statistics. According to the July Bulletin of the British Iron and Steel Federation the number of people in employment in iron foundries as at June 7 was somewhat fewer—actually 455—than a month earlier. It was, however, distinctly greater (by 4,316, than a year ago. Steel foundries on the other hand showed at 20,534 an increase of 226. A year earlier 19,052 were employed. In the iron and steel industry, the average weekly earnings were £9.37 as against £8.58 in June 1951. The average weekly production of liquid metal for steel castings was 10,600 tons in June as against 11,300 in May and 9,900 in June, 1951.

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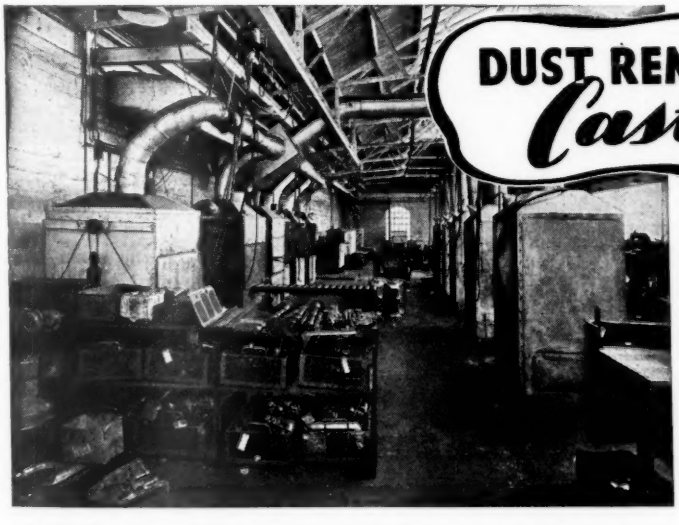

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

August 27, 1952

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 1s. 6d.; Birmingham, £12 15s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £13 17s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent P, up to 3 per cent. S), d/d within 60 miles of Stafford, £15 5s. 9d.

Scotch Iron.—No. 3 foundry, £14 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £17 4s. 6d.; South Zone, £17 7s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £17 14s. 6d.; South Zone, £17 17s.

Cold Blast.—South Staffs, £18 2s.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £13 11s. 6d.; Scotland (Scotch iron), £13 18s.; Sheffield, £14 12s. 6d.; Birmingham, £14 19s.; Wales (Welsh iron), £13 18s.

Basic Pig-iron.—£12 10s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45% Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75% Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 22s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204; ditto, copper-free, £212.

Ferro-tungsten.—80/85 per cent., 28s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 31s. 7d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60% Cr, scale 28s. 3d. per unit; 6/8 per cent. C, £80 17s., basis 60% Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr.: max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 6s. 9d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £43 15s. 2d.

Metallic Manganese.—93/95 per cent., carbon-free, £262 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £23 4s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £25 14s. 6d.; hard (0.42 to 0.60 per cent. C), £27 12s.; silico-manganese, £33 8s.; free-cutting, £28 8s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £31 9s.; case-hardening, £31 17s.; silico-manganese, £34 9s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 8s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 8s.; acid, up to 0.25 per cent. C, £31 17s.

Sheet and Tinplate Bars.—£25 3s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £29 14s.; boiler plates (N.-E. Coast), £31 1s. 6d.; chequer plates (N.-E. Coast), £31 3s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £27 17s.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 15s. 6d.; flats, 5 in. wide and under, £31 15s. 6d.; hoop and strip, £32 10s. 6d.; black sheets, 17/20 g., £41 12s. 6d.; galvanized corrugated sheets, 24 g., £53 6s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £50 18s. 3d.; nickel-chrome, £71 7s. 9d.; nickel-chrome-molybdenum, £79 2s. 6d.

Tinplates.—57s. 1¼d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £285; high-grade fire-refined, £284 10s.; fire-refined of not less than 99.7 per cent., £284; ditto, 99.2 per cent., £283 10s.; black hot-rolled wire rods, £294 12s. 6d.

Tin.—Cash, £963 to £964; three months, £945 to £946; settlement, £963.

Zinc.—G.O.B. (foreign) (duty paid), £122; ditto (domestic), £122; "Prime Western," £122; electrolytic, £126; not less than 99.99 per cent., £128.

Lead.—Good soft pig-lead (foreign) (duty paid), £131; ditto (Empire and domestic), £131; "English," £132 10s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £142 15s.; rolled zinc (boiler plates), all English destinations, £140 15s.; zinc oxide (Red Seal), d/d buyers' premises, £142.

Other Metals.—Aluminium, ingots, £157; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £64 10s. to £64 15s.; nickel, £454.

Brass.—Solid-drawn tubes, 27½d. per lb.; rods, drawn, 37½d.; sheets to 10 w.g., 31½d.; wire, 33d.; rolled metal, 30d.

Copper Tubes, etc.—Solid-drawn tubes, 32½d. per lb.; wire, 317s. 9d. per cwt. basis; 20 s.w.g., 346s. 3d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £212 to £218; BS. 1400—LG3—1 (86/7/5/2), £235 to £238; BS. 1400—G1—1 (88/10/2), £352 to £375; Admiralty GM (88/10/2), virgin quality, £375 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £365 to £385; L.P.Bl, £250 to £275 per ton.

Phosphor Bronze.—Strip, 44d. per lb.; sheets to 10 w.g., 46½d.; wire, 49½d.; rods, 44½d.; tubes, 42½d.; chill cast bars: solids 4s. 4d., cored 4s. 5d. (C. CLIFFORD & SON LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 9½d. per lb.(7%) to 3s. 10½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 3½d. (7%) to 4s. 4½d. (30%); to 12 in. wide × .056, 3s. 3¾d. to 4s.4½d.; to 25 in. wide × .056, 3s. 5½d. to 4s. 6½d. Spoon and fork metal, unsheared, 3s. 0½d. to 4s. 1½d. Wire, 10g., in coils, 3s. 9¾d. (10%) to 4s. 10½d. (30%). Special quality turning rod, 10%, 3s. 8¾d.; 15%, 4s. 2d.; 18%, 4s. 6½d. All prices are net.

Obituary

MR. THOMAS W. RAFFEL, who died recently at the age of 66, was a partner in Johnstone & Clark, engineers, of Dumfries, with which he had been associated for practically all his working life.

MR. JOSEPH GEORGE SWEENEY, who died on August 19 at Bickenhill, was managing director of Buswell & Sweeney, Limited, engineers, of Watery Lane, Birmingham. A Gloucestershire man, he came to Birmingham to join the Wolseley Motor Company before the first world war, and became head of the firm's aeroplane department. He left this Company to found, with Mr. Buswell, the firm with which he has latterly been associated.

THE DEATH took place on August 16 of COLONEL T. M. HUTCHINSON, a director of the Hammond Engineering Company, Limited, manufacturers of rotary compressors, exhausters and pumps, of Enfield (Middx). He had a long and distinguished career in the Army, being appointed Chief Inspector of Mechanical Transport to the B.E.F. in France and Flanders in 1915. From 1920 to 1924 he was War Office Inspector of Mechanical Transport, while from 1926 to 1930 he served as Mechanical Transport Adviser to the India Office. He was 75.

Board Changes

M. COCKBURN & COMPANY, LIMITED—Mr. R. L. Hunter has been appointed managing director.

BURTON FOUNDRY COMPANY, LIMITED—Mr. D. F. Campbell has been appointed managing director.

Incorporated Plant Engineers.—The Peterborough branch of the Incorporated Plant Engineers are to make an evening visit to Baker Perkins, Limited, Westwood Works, Peterborough, on September 4.

Sir John Cass College. The Sir John Cass College, Jewry Street, Aldgate, London, E.C.3, is embarking on a particularly extensive programme of lecture courses. Included in the subjects dealt with are petroleum technology; domestic and industrial fuel; radio-chemistry and radio-activity; ferro-electricity; electron diffraction; heat-transfer in chemical plant; statistical methods in scientific and industrial research; spectro-chemical analysis; industrial law; and microbiology. Details of each one is set out on a separate sheet and copies of these are available from the principal of the College at the address printed above.

Personnel Management Conference.—Lord Terrington, chairman of the Industrial Disputes Tribunal, will speak on "Arbitration in Industrial Disputes"; followed by Sir Cuthbert Clegg, past-president of the British Employers Confederation on "Employers' Organizations and Labour Relations" and Mr. Charles Morris, vice-Chancellor, University of Leeds, on "Can the Universities teach knowledge of human nature?" at the national conference of the Institute of Personnel Management at Harrogate from October 10 to 12. Sir Walter Monckton, Minister of Labour is to give the opening address and other principal speakers include the ven. Mervyn Armstrong, Archdeacon of Stow; Mr. Nigel Balchin, author, and Mr. Graham Hutton, economist, each of whom will discuss aspects of personnel management in modern industry.

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Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, 49, Wellington Street, London, W.C.2. If received by first post Tuesday advertisements can normally be accommodated in the following Thursday's issue.

SITUATIONS WANTED

YOUNG FOUNDRY FOREMAN, trained as metallurgist, desires change. Keen and competent. H.N.C. and City and Guilds. Yorkshire area preferred.—Box 2005, FOUNDRY TRADE JOURNAL.

ASSISTANT Iron Foundry MANAGER/METALLURGIST (28). All-round practical and technical experience in modern mechanised and general foundries. High duty irons, cupolas, sand. Any progressive position considered. Married; accommodation essential. — Box 1988, FOUNDRY TRADE JOURNAL.

METALLURGIST (30), with Hons. Degree, desires position as WORKS METALLURGIST. Experience in control of melting and casting of non-ferrous metals.—Box 1993, FOUNDRY TRADE JOURNAL.

ENERGETIC young man (26), A.M.I.Brit.F., apprenticed pattern-maker, C. & G. (Full Tech.), seeks progressive foundry position.—Box 2012, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive or a woman aged* 18-59 *inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order* 1952

ANALYTICAL CHEMIST, with Higher National Certificate or equivalent, required in East Anglia. Experience in analysis of plain and alloy cast irons, mild and alloy steels (including stainless), copper base alloys and aluminium, cupola slags and fuels.—Please state experience, education, and salary required, to Box 1999, FOUNDRY TRADE JOURNAL.

AGENTS required on commission basis by Midland Repetition Ironfounders, making light castings in Grey and Whiteheart Malleable. Areas available include North Midlands, Yorkshire and North-East Coast.—Please apply, giving full details in strict confidence, to Box 1992, FOUNDRY TRADE JOURNAL.

LARGE Synthetic Resin Manufacturers have a vacancy for an energetic young man with a good experience of modern foundry practice and the foundry industry, for development work in the use of synthetic resins for core bonding and shell moulding. This is a new field and offers considerable scope for the right man. —Apply to Box 2004, FOUNDRY TRADE JOURNAL.

ESTABLISHED Iron Foundry, North Midlands, requires genuine active Partner, take full control, or sleeping Partner. Capital necessary £1/3,000. Excellent prospects.—Box 1997, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

EAST Anglian Foundry requires intelligent young METALLURGIST, age 21 years or over, to control small metallurgical laboratory. Work includes ferrous and non-ferrous analysis, plant control, and general metallurgical investigations.—Apply CHIEF METALLURGIST, Suffolk Iron Foundry (1920), Ltd., Stowmarket, Suffolk.

ASSISTANT FOREMAN, to take charge of a Machine and Floor Moulding Bay in Jobbing Foundry. Must have cupola knowledge. State experience and salary required.—Box 2011, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER required for modern foundry, manufacturing castings, 2 lbs. to 5 tons. Please give full particulars of experience etc. to Box 2010, FOUNDRY TRADE JOURNAL.

ASSISTANT FOREMAN take charge mechanised small castings bay and core shop, Bristol district. State experience and salary required.—Box 2008, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN, age 30/35, experienced in ferrous and non-ferrous machine moulding and jobbing practice, required for Middlesbrough foundry controlled by progressive engineering firm on North-East coast. Foundry has modern building and equipment.—Box 2007, FOUNDRY TRADE JOURNAL.

ASSISTANT FOUNDRY MANAGER wanted in Glasgow District for Iron Foundry producing high grade Iron Castings for Marine Engines and General Engineering. Young man with technical and practical knowledge of modern foundry methods and capable of controlling craftsmen and other workers. State experience, age, and salary required.—Write 2282, WM. PORTEOUS & Co., Glasgow.

PATTERNMAKER, first-class, required by large Foundry—in Republic of Ireland—producing high quality domestic appliances. Must be experienced in Plaster, Lead and Tin and Wood pattern equipment for both machine and floor moulding. The position offers scope and variety, together with good salary, for keen man. House available for successful applicant.—Write in first instance, giving particulars of experience, etc., to Box 1968, FOUNDRY TRADE JOURNAL.

NEWLY formed Research Organisation, with headquarters in Birmingham, requires the services of a TECHNICAL SECRETARY to co-ordinate its work. Although duties will be largely Secretarial and Administrative, applicants must have engineering and metallurgical qualifications in Iron and Steel. Position would be for a preliminary period of one year, but would be permanent if satisfactory results achieved. Salary according to experience and qualifications.—Apply to: "Research," PEAT, MARWICK, MITCHELL & Co., Lombard House, Great Charles Street, Birmingham, 3.

SITUATIONS VACANT—*Contd*

ASSISTANT FOUNDRY SUPERINTENDENT required by Non-ferrous Founders, Middlesex. City and Guilds standard essential.—Write, with full details of experience, technical training, age, and salary expected, to Box 2006, FOUNDRY TRADE JOURNAL.

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Applications are invited for admission to the two-year Diploma Course which opens on 22nd September, 1952. Sufficiently qualified candidates may enter directly in to the final year. The Prospectus of the College lists the necessary qualifications and other relevant information. Prospectuses and forms of application may be obtained, post-free, from the Head:—

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NON-FERROUS FOUNDRY, Kent, requires additional capital, £3/5,000. Established 5 years. Government contracts, £25,000. Potential capacity approx. 30 tons per month. Sand and Die Castings. Area approx. 9,000 sq. ft., with ample room for extension. Full details upon request.—Box 1977, FOUNDRY TRADE JOURNAL.

PATENT

THE Proprietors of Patent No. 546,104, for "Process and Apparatus for Reducing Divided Material such as Ores containing Solid Oxides with Reducing Gas," desire to secure commercial exploitation by licence or otherwise in the United Kingdom.—Replies to HASELTINE, LAKE & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

BUSINESSES FOR SALE

PATTERN SHOP for Sale. Freehold premises, in centre of town, 25 miles from London. Good contacts. Highly skilled staff, accustomed to aircraft and motor work.—Box 1944, FOUNDRY TRADE JOURNAL.

IRON FOUNDRY.—For sale as a going concern. Situated 25 miles west of London. Foundry floor area 6,400 sq. ft., total area 9,000 sq. ft. Fully equipped with fettling, core and pattern shops, casting stores. Adequate yard area, two cupolas, two new moulding machines. Present output 12 tons per week, potential output 25 tons per week.—Box AC 74834, SAMSON CLARKE, 57/61, Mortimer Street, W.1.